THE

ELECTRICAL REVIEW.

VOL. LXV. NOVEMBER 26, 1909. No. 1,670.

ELECTRICAL REVIEW.

Vol. LXV.] CONTENTS: November 26, 1909. [No. 1,670.

	Page
The Present Aspect of Electric Lighting	841
Copper	842
Publicity	843
Gas *v.* Electricity	843
The Rees Roturbo Centrifugal Pump (*illus.*)	844
Some Rambling Notes from India	846
Correspondence:— Single-Phase Motors — Some Business Anomalies—Protection in Natal—Protection of Tramway Trolley Standards—A Question on Load Factor—Voltages for Country House Installations—Electric Lighting for Villages—The "Steady Job"—A Correction—Institution Proceedings	847 to 850
Proceedings of Institutions:—	
The Electric Ignition of Internal Combustion Engines (*illus.*)	850
Institution of Electrical Engineers (Glasgow)	853
Institution of Electrical Engineers (Newcastle-on-Tyne)	854
Legal	854
London Electric Supply Companies and Compulsory Purchase	857
Business Notes	858
Notes	864
City Notes	867
Market Quotations	868
Stocks and Shares	868
Share List of Electrical Companies	869
Exports and Imports of Electrical Goods during Oct., 1909	871
Cable-Fault Localisation Graphs in Practice (*illus.*) (*concluded*)	872
Notes on Trade Abroad	873
More Notes from India	875
A New Field-Magnet System (*illus.*)	876
A Pennsylvania Electric Locomotive (*illus.*)	878
Our Legal Query Column	879
Foreign and Colonial Tariffs on Electrical Goods	879
New Patents Applied For, 1909	880
Published Specifications	880
Contractors' Column ... ... Advertisement pages 66 and 68	

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. *Established 1872.*

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address: "AGREKAY, LONDON." Code, A B C.

Telephone Nos.: Holborn 933; Central 4425 (Editorial only).

ALL Letters should be addressed to the Proprietors, H. Alabaster, Gatehouse & Co.

ADVERTISEMENT RATES ON APPLICATION.

The "Electrical Review" is the recognised medium of the Electrical Trades, and has

BY FAR THE LARGEST CIRCULATION

of any Electrical Industrial Paper in Great Britain.

SUBSCRIPTION RATES.—Per annum, postage inclusive, in Great Britain, 19s. 6d.; Canada, £1 1s. 8d. ($5.30). To all other countries, £1 10s.

BINDING.—Subscribers' numbers bound, including case, for 4s. each volume.

CASES.—Cloth Cases for Binding can be had, price 2s. 6d. each; post free 2s. 9d.

READING CASES, to hold from One to Twenty-six Numbers until the volume is complete for Binding, can be had from the Publishers, Price 6s., or Free by Post (in Great Britain), 6s. 6d.

FOREIGN AGENTS.—New York: D. VAN NOSTRAND, 23, Murray Street. TORONTO, ONT.: WM. DAWSON & SONS, LTD., Manning Chambers. Paris: BOYVEAU & CHEVILLET, 22, Rue de la Banque. Berlin: ASHER & Co., Unter den Linden.

Cheques and Postal Orders (on Chief Office, London) to be made payable to Mr H. ALABASTER, 4, Ludgate Hill, E.C.

THE

UNIVERSAL ELECTRICAL DIRECTORY

(J. A. BERLY'S).

1910 EDITION IN PREPARATION.

H. ALABASTER, GATEHOUSE & CO.,

4, Ludgate Hill, London, E.C.

THE PRESENT ASPECT OF ELECTRIC LIGHTING.

THE paper on the above subject, read last night at the Institution of Electrical Engineers by Messrs. Handcock and Dykes, is a further contribution to the problem of how to charge for electric lighting, with special reference to the supply of small houses.

The authors believe that the flat-rate system has failed to meet the new conditions which have resulted from the improved lamp, and they put forward data showing the difficulty of securing an adequate return upon the capital invested in the case of small consumers and free-wired installations. They maintain, however, that by the adoption of a suitable method of charging this can be done, and, further, that the field at present occupied by gas can be successfully invaded. On the face of it, it is only reasonable to anticipate that so marked a reduction in the cost of lighting by electricity should immediately facilitate the substitution of electric light for gas on small premises.

The Electric Lighting Act is elastic as to methods of charging, the only real limitation being in the maximum rate which is governed by the fourth schedule of the Provisional Orders; under its first section the rate is usually fixed at 8d. per unit, with the right of charging a minimum for any amount of energy consumed up to 20 units. In practice these limits are rarely put in force, the flat rate charged being generally much below this maximum, and the minimum charge frequently abandoned to meet the objections of consumers, who dislike paying for what they do not receive.

Under the Electric Lighting Act of 1882, Clause 18 expressly provides that the suppliers of electricity "shall not be entitled to prescribe any special form of lamp or burner to be used by any company or person, or in any way to control or interfere with the manner in which electricity supplied by them under this Act is used"—provided that it does not interfere with the supply to other users; and under Clause 20, no undue preference may be shown between one customer and another. To raise the price of energy simply because of the greater efficiency of the metallic-filament lamps would be unwise, as we pointed out in our issue of March 12th last.

Of course, much is to be said in favour of a system which equitably provides for dealing with the long-hour consumer, and Wright's maximum-demand system went far towards meeting the case; but the failure of the public to understand it has made it difficult of application. If the electric lighting accounts had been collected half-yearly so as to avoid the discrepancy between the winter and summer accounts, instead of quarterly, when the summer quarter's excessive charge for a small consumption created dissatisfaction, probably there would have been less complaining.

Messrs. Handcock & Dykes suggest other methods of charge, based upon certain fixed prices per lamp per annum, and propose two systems which they distinguish as the "Contract" and the "Contract Demand," practically designed to secure a guaranteed revenue from the supply of energy, irrespective of the quantity consumed.

The Norwich system of securing a certain revenue, based upon the rating value of the houses instead of the maximum demand, and charging a flat-rate (in addition to the fixed assessment) of 1d. per unit for all purposes, is said to have worked very well, and Mr. Long, the inventor, has expressed his satisfaction with the results obtained. It is doubtful,

however, whether it could be generally applied. The rating value of houses depends upon their position in the town; in some cases premises consuming the same amount of electricity and having the same maximum demand may be rated at half as much as others in more desirable areas, and to charge one resident nearly double the price for his energy, because he pays double the amount of rates, cannot be justified.

A charge of so much per lamp per annum is another method referred to, but this also is wrong in principle, as some lamps will be used for much longer periods than others; besides, the facility for changing them from one candle-power to another, at the will of the consumer, is another practical difficulty. On the other hand, the supply authority, and not the consumer, would be the loser if the contract were not observed in the spirit, and therefore this system is free from the objection that it differentiates inequitably between consumers. Seeing that, in a small installation of metallic-filament lamps, the standing charges for supply bulk so largely compared with the small cost of producing the energy supplied, it cannot be denied that the arguments in favour of this system have been greatly strengthened by the new conditions.

In order to avoid the tendency to limit the number of lamps installed, the authors, as in their former paper, suggest the use of a device setting a fixed limit to the number of lamps in use at one time, but leaving the number installed uncontrolled, and they propose to charge the full contract price only for the former, while making a small charge for each of the latter, assuming them to be wired by the supply authority. This constitutes the "Contract Demand" system.

In both cases the cost of the meter is avoided, and a single service could be used to supply a whole block of the small houses that the authors have under consideration.

For larger houses, the ordinary systems of charging by meter are not likely to be displaced; after all, there is nothing so readily understood by the public as the flat rate system of paying so much per unit as recorded on the meter. This is what the public have been accustomed to in paying for their gas, and although probably very few people ever look at their meters, which are installed in cellars and out-of-the-way places, they are satisfied, because the system is readily understood.

Another principle suggested by Messrs. Handcock and Dykes is to charge for *light* and not electrical energy. Thus they propose a sort of lump-sum charge for lighting a house, including the wiring and supply of lamps. Of course, the obvious objection to such a system is that the charge must be based upon the *possible* consumption of energy, and not upon any general average of ordinary usage; probably, in practice, people would not, as a rule, keep lamps burning day and night, or have an excessive brilliancy of illumination simply because it cost them no more, but there would be nothing to prevent their being very long-hour and extravagant consumers at the expense of the lighting station.

Apart from the consumption of current in the new lamps being so small, another important feature is their longevity, which far exceeds that of the best carbon lamps, thus securing for the consumer a greater economy than was contemplated when they were first introduced. This is a most important point, when comparing the electric light with that of the most up-to-date gas mantles. The metal-filament lamps are found to last as long as 2,000 hours, *without any material reduction in the light*, whereas the incandescent gas mantles deteriorate within a few weeks of being installed and require frequent renewals. The public appear to be grasping the new conditions, and the prospects of the electric lighting companies are therefore rapidly improving.

COPPER.

Although the price of copper cannot be considered high, it remains a subject for surprise that it does not exhibit a marked tendency to go lower. The visible supplies, as shown by Messrs. Merton's circular for November 15th, have now surpassed the 100,000 tons anticipated in these columns, and reached the figure of 102,952. Deliveries, on the other hand, are, if anything, low, being only 28,025 tons for last month, and 16,018 for the first half of November. American demand is reviving, as evidenced (amongst other indications) by a re-shipment of 50 tons, but buyers in this country still hold off, on the principle, apparently, that the market is not weak, and, if approached by two or three well-known buyers, would promptly respond by an increase in price.

The various financial papers are exercised by rumours of an extensive combination, but, as yet, can give no certain information on the subject. Obviously, if such a combination exists, it is not working with quite the smoothness desired by "bull" operators. One would have expected the market to decline slowly but firmly to something lower than the present value, finishing up with a "slump" to favour the extensive buying operations to precede the rise. This does not appear to be so easy to manage as formerly. But, if nothing of the kind is in progress, why these continually increasing visible supplies fed into the innocent and trusting European market? It cannot be supposed that the control is anywhere but in the hands of the largest producer. We must fall back upon the theory of divided interests.

The *Financial Times* is rather inclined to support this view. In an article of November 4th on the outlook, the writer says, "Undoubtedly there are interests that would like to bring about an agreement for the 'betterment of the industry,'" but it is difficult to see how the opposition of the Guggenheims, the Calumet and Hecla and other producers who persist in selling their copper for what it will fetch on the market as fast as it can be produced, can be overcome. Again, "The new low-grade mines in Nevada, Utah and Arizona, which are being rapidly developed, are mining at a cost of 9 cents per lb. or less, and they are not likely to restrict their earning capacity out of consideration for their older competitors." This latter argument does not persist if the cheap producer gets his own terms in a combination, surely. Here, however, we have a summing up on the side of continued low prices.

Later, November 16th to be precise, the same paper tells us that reports were freely circulated (in the States) that an agreement had been reached to make a combination with a capital stock of a billion dollars, which would embrace practically all the producing copper interests; further, that these reports were emphatically denied. The report alluded to, the *Financial Times* explains later, asserts that a combine is to be formed on the same basis as the United States Steel Corporation, and that the combination will include all the big producing mines, that all the large producers will agree to sell through one agency and eliminate price-cutting, and that the Rio Tinto and Calumet and Hecla companies will join the combine. The information which the paper endeavoured to secure on the subject was necessarily rather vague, but pointed to the inception of such a combine, although inclined to the opinion that the Rio Tinto and some of the cheaper producers were at present holding out.

The *Financier*, in an article in their issue for November 4th, attributed the present price to excessive production during the last two years. This article did not consider that a combination could be attended with results satisfactory to the producers, and was inclined to anticipate a continuance of moderate

price. On the 10th, the *Daily Telegraph* correspondent published a fairly assured intimation that the combination was in progress. "Unofficial statements," says this report, "say that the companies certain to be in the merger, include the Amalgamated Copper Co., the Cole and Ryan properties, the Phelps and Dodge interests, and the Guggenheim interests, and, perhaps, also the Calumet-Hecla Co., though the latter has thus far declined to enter into negotiations."

On the 13th inst. the *Financier* announced that the Arizona Copper Co., the only American copper company controlled in this country, had been approached on behalf of the combine, and that the chairman was about to leave for New York, in order to conduct negotiations on the spot. This notice gave as the moving spirit Messrs. J. P. Morgan & Co., with the Cole-Ryan interests, and, consequently, the Amalgamated Copper Co. The leading European mines were not to be included. This news as to the Arizona Copper Co. also appeared in the *Times* of the 15th.

In commenting on the situation on November 17th, a writer in the *Financier* says: "Though still lacking official confirmation, the report that steps are being taken to establish a great combine of American copper producers may be accepted as substantially correct." This article does not anticipate that an American combination could control the market to its own satisfaction. Any advance in prices would be followed by increased production in the free European mines.

In the face of this evidence there can be little doubt that a combination is being attempted, cautiously, and, therefore, with more chance of satisfactory agreement and strength. Such an organisation can hardly fail to have an influence on prices, in the upward direction, especially when first officially announced. From the slowness with which it is being effected, and the apparently premature announcement of its existence, it would seem that many important firms are holding off, and, under these circumstances, a serious position for the consumer need not be anticipated. If he can contrive to hold off at the present price, he will find some mode of existence which will not force him into the market at a higher one.

Publicity.

In our last issue we advocated the reform of procedure at Institution meetings. Another matter on which we wish to comment is of less general interest, as it relates only to the Institution of Civil Engineers and its attitude towards the technical Press. We refer to the strict rule of the Institution which forbids the publication of papers and discussions except in its own *Transactions*. In this respect the Institution of Civil Engineers stands alone and aloof. We may not even publish a condensed report of the proceedings at its meetings; we are permitted only to reproduce an official abstract of a paper, which usually is confined to the heads of discussion, and is remarkably free from useful and interesting data. A notable example of this practice occurred in our last issue; three interesting and valuable papers on electric railway traction were read before the Institution on the 9th inst. (they were not then discussed; as pointed out by a correspondent, there was no time), and on Tuesday last week they were discussed—but the reproduction of the official abstracts, of which we gave the gist, was the extent of our privileges. We do not for a moment question the right of the Institution to avoid publicity in this way; it is fully entitled to hold its meetings *in camera*, and to conduct its proceedings in secrecy—if its members so desire.

It may be that the Council believes that by this means engineers will be forced to become members, in order to receive the papers and discussions *in extenso*. We doubt, however, whether the members as a body are in favour of this course; the views of the Council are not necessarily those of the members, and may in fact be diametrically opposed to them.

We question also the wisdom of the procedure; there was a time when close corporations, guilds and secrecy were the rule—but publicity is the key-note of the present day, and that "it pays" is well exemplified by the phenomenal growth of the Institution of Electrical Engineers, which has nearly doubled its membership in ten years, shows no sign of approaching a limit, and at no distant date will certainly exceed in numbers the Civil Engineers, which, indeed, is the only Institution of the kind possessing a larger membership.

There are signs of an awakening in the counsels of the Institution, which may bring about a reform in this as in other directions. We admit that our attitude may be regarded as biased in the interests of our readers; on the other hand, the whole of the technical Press would share in any extension of privilege, and we firmly believe that the removal of the present restrictions would prove advantageous not only to the ordinary engineer, but also to the Institution itself.

Gas v. Electricity.

It is interesting to note that gas engineers are beginning to imitate, so far as they are able, the example of electrical engineers in hiring out lamps. Mr. H. N. Clark, of West Ham—where he has found the competition of the electricity supply department particularly keen—read a paper on the subject at a recent meeting, which was reproduced in the *Gas World* on November 6th; from this we learn that a two, three or four-burner gas lamp is rented at a rate of 6s. per quarter, the net profit being 5s. 6d. at the end of four years (if the lamp lasts so long) plus the profit on the gas supplied. No allowance is made, so far as we can see, for interest on capital, which would swallow up the small profit hoped for.

For £2 1s. per quarter the Corporation supplied (and fixed) a flame arc lamp, including energy for burning 800 hours. As the cost of the gas is not stated, we cannot further compare the rival schemes; but the fact that the gas people are following the electrical example is a good sign—a sign that they are "feeling the draught." Attempts have been made also to evolve illuminated gas signs, which have "attracted much attention" and "produced many inquiries," but apparently are in use only at the gas company's showrooms. In this department electricity is so obviously paramount, that we can only wonder at the temerity of the gasicians in trying to invade the field.

For high-pressure gas lighting, Mr. Clark, with admirable taste, recommends the electrically-driven blower as a stand-by, lest the gas-driven blower should fail. But why put in the latter at all?

Criticising the electricity department, the author states that a 50-c.p. Osram lamp is rented at 4s. 9d. per quarter, including the supply, fixing and maintenance of wiring, and energy at 1¼ watts per candle. At 3d. per unit, the energy costs 15s., leaving 4s. to cover maintenance, renewals and installation charges, a sum which he regards as absurd, unless maintenance is free. But the useful life of Osram lamps averages far more than 1,000 hours; moreover, the cost of supplying lamps which are used 1,000 hours per annum is not nearly 3d. per unit, so that the cost of energy is much smaller than he estimates. The cost of maintenance of an installation of wiring and fittings, of sound workmanship and material, is so small as to be practically negligible, and interest and depreciation on the cost of the installation are readily covered by 1s. per lamp per annum. There is, therefore, no reason to suppose that the rate does not return a reasonable profit.

In several places, we gather from the discussion, the maintenance of gas burners is being undertaken free of cost for labour, only materials being charged for; Mr. Clark admitted that they must look to the inverted gas burner to enable them "to maintain the premier position," and that it was "a little less easy to manipulate" than the upright type—hence the free labour.

One speaker was surprised that an electric stand-by should be suggested, and pointed out that the high-pressure installation in Fleet Street was worked without the aid of electricity. Four engines are used, as it appears, *one at a time*. The stand-by, therefore, is three times the size of the running plant. Comment is needless.

THE REES ROTURBO CENTRIFUGAL PUMP.

The centrifugal pump, although an old type (that is to say, it became a practical machine between 1845 and 1850), had great limitations for the first 50 years of its existence, its defects being low efficiency, and the few conditions to which it could be applied. Until about ten years ago it was generally agreed that centrifugal pumps were only suitable for low lifts and large volumes of water—such as occur in irrigation, sewage and salvage work, and for circulating water for condensation.

The whole theory of the centrifugal pump was, however, worked out for the early designers before the conditions of engineering could allow it to be fully applied, and Prof. Unwin's paper before the Civil Engineers in 1877-8, giving a complete review of the knowledge up to date, is still, and is likely to remain, a standard work on centrifugal pump design.

The enthusiasm of the early designers and their conviction that the centrifugal type should not be limited to a few of the problems in the pumping world, is shown by the patents taken out in the attempts to overcome the well-known difficulties, and to make the centrifugal suitable for high lifts by using a number of impellers in series.

No doubt the delayed development was due to the fact that to get the best results on a centrifugal pump, impellers should be of small diameter running at a high speed, rather than of large diameter running at a low speed, but until the advent of the electric motor there was no means of driving centrifugal pumps at the necessary speeds except by means of belting or gearing, and to gear up from a slow speed steam engine to the 1,600 or 2,000 revolutions, or even higher speed sometimes desirable on a centrifugal pump, created difficulties and losses in transmission which neutralised the advantages aimed at in the design of the pump.

The reason for the high speed lies in the fluid friction of the revolving impeller. The head which a centrifugal pump will work against increases as the square of the peripheral velocity, that is to say, the most economical head is approximately $\frac{v^2}{2g}$, v being the peripheral velocity of the impeller in feet per second. This peripheral speed can be attained either by a small impeller running at a high speed, or a large impeller running at a low speed, but as the impeller is running in the fixed casing of the pump, and is surrounded by water, there is a certain amount of friction between the revolving disk and the water in the casing, which is a constant quantity whether the pump is discharging water or running on a closed valve. As impellers are increased in diameter, this fluid friction increases at a much greater rate than the increase of head. Stated briefly, for a given speed of rotation, the head, or height of lift, increases as the square of the diameter, but the fluid friction increases approximately as the fifth power. This law is quite sufficient to account for the fact that the centrifugal pump began a fresh development when electric motors came into general use, and is the reason of the improved efficiencies which then became possible. The old arrangement of impellers in series was revived so as to give higher lifts, and the centrifugal pump became a strong competitor of the ram pump for conditions which used to be looked upon as only suitable for reciprocating pumps.

Perhaps the defect which has been the most difficult to overcome, and which has decided the buyer in many cases against this type of pump, has been the fact that it would only work at its best at the exact head for which it was designed, the reason of this being that the blades of the impeller were shaped so as to pass a certain amount of water with the minimum friction or loss due to cavitation; but if the head against which a centrifugal is working is reduced, a greatly increased volume of water passes, and the impeller then becomes unsuitable for the increased speed of the water through it, and begins to act as a water brake, the power on the driving machine being increased very greatly. Large numbers of motors driving centrifugal pumps have given trouble, or been burnt out (if they had not a large margin of power), due to the overload created by an unsuitable head against the pump.

These conditions were well known, and it was attempted to overcome them by bending the blades of the impeller in a rearward direction, so as to reduce the brake effect, but in Unwin's paper the effect of this re-curvature is very clearly shown, in that the speed of the impeller has to be increased to compensate for the slip of the water, and beyond a certain amount of re-curvature the *capacity* of the pump is very greatly reduced, and the internal friction of the impeller increased.

Our illustrations of the Rees Roturbo pump shows one of the latest type of centrifugal pumps, in which the problem of varying heads is completely solved. In this pump, the departure from the ordinary practice is in the impeller, which, instead of being built as a flat disk with recurved blades is in the form of a drum, with large internal capacity to secure a constant internal pressure which is independent of the head (see fig. 7).

The inner portion of the impeller between the eye and the largest section of the pressure chamber which is near the rim may be looked upon as a centrifugal pump proper, and the blades in this portion of the impeller are designed as in an ordinary centrifugal pump. The rim portion, beyond the pressure chamber, is designed as a reaction turbine, having rearwardly directed nozzles discharging from the pressure chamber.

The impeller, therefore, becomes a pump and a turbine in series, with a pressure chamber between the two portions. The pump portion is, therefore, always discharging *into* a constant pressure, which is the ideal condition for a centrifugal pump, and the turbine is always discharging *from* a constant pressure, which is the ideal condition for a turbine.

The result of the combination of pump and turbine, with pressure chamber between them, is that the self-regulation is perfect, and at any head lower than the normal duty, the power taken by the motor is prevented from rising.

As the speed of the water in passing through the pressure chamber is reduced, internal friction is reduced to a minimum, and a high efficiency is secured without the necessity of machined or polished blades or surfaces. It is claimed that internal wear is also minimised.

In practice it is found with this type of pump, that the highest efficiency point is at a duty in which the speed of the water issuing from the turbine blades is about half the peripheral speed of the impeller, consequently, the resultant speed up the cutwaters in the fixed casing is also only half the peripheral speed of the impeller, this being the reason given for the reduced wear when pumping gritty water.

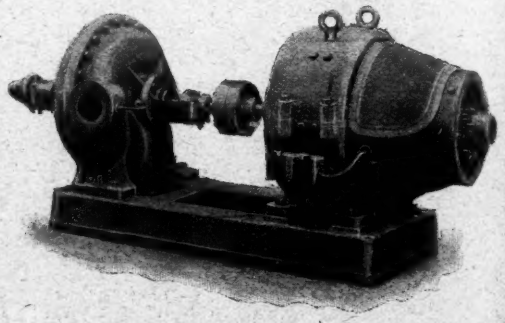


Fig. 1.—Motor-driven Fire Pump, Bengal Nagpur Railway

The illustrations show examples of these pumps for a wide range of duties. Fig. 1 shows a motor-driven pump, one of several supplied for fire purposes to the Bengal Nagpur Railway, to the specification of Sir John Wolfe Barry.

The motor is of the Rees Roturbo continuous-current gapped-frame type, from which the armature can be removed by a vertical lift on removing the top half of the magnets.

Each pump is capable of dealing with 48,000 gallons an hour, to a total height of 160 ft. The pumps supply water to systems of water mains for fire purposes, and are so designed that the pressures are maintained within a margin of 15 per cent. from full delivery to no delivery, when all valves are closed.

Fig. 2 is a boiler feed-pump for the Chester Corporation, also driven by a Rees Roturbo continuous-current gapped-frame motor. The pump impellers are 8½ in. diameter, and the water passes through eight pressure chambers in series.

The boiler pressure against which the pump is designed to work is 175 lb. per sq. in., the speed of the set being 1,725 to 1,625 revolutions, the lower speeds being arranged for speed regulation if desired for lower duties.

The duties, with the efficiencies guaranteed, were as follows :—2,000 gallons an hour, 40 per cent. efficiency; 4,500 gallons an hour, 48 per cent. efficiency; 6,500 gallons an hour, 60 per cent. efficiency.

Fig. 3 is a curve of the actual performance of the pump, in which it will be seen that the guaranteed efficiencies were exceeded.

Fig. 4 is an interesting example of a centrifugal pump at a comparatively low speed—namely, 925 R.P.M., the high efficiency of over 84 per cent. attained in this case being due to the fact that the volume of water was sufficient to

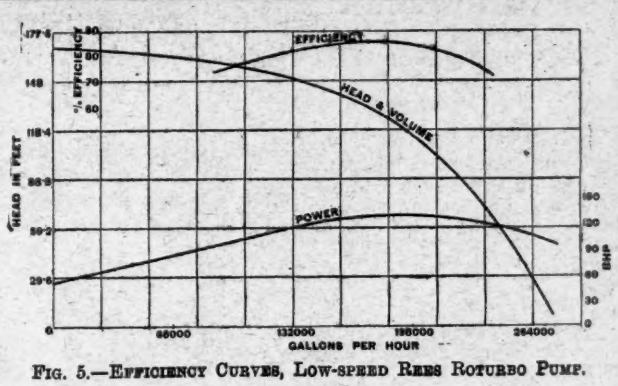


Fig. 5.—Efficiency Curves, Low-speed Rees Roturbo Pump.

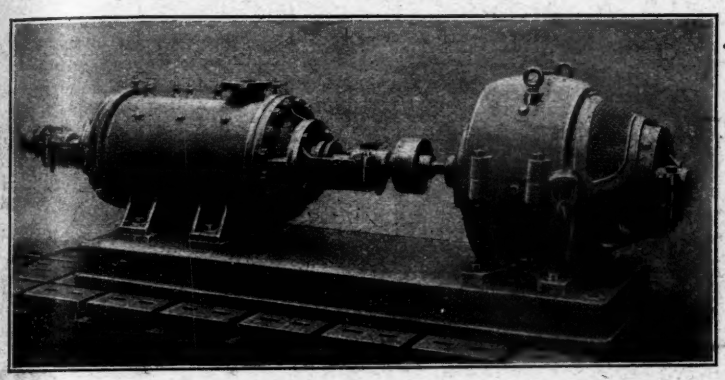


Fig. 2.—Rees Roturbo Boiler Feed Pump, for 175 lb. pressure.

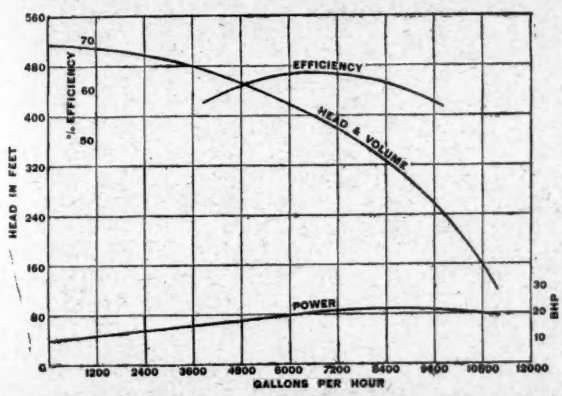


Fig. 3.—Efficiency Curves, Rees Roturbo Boiler Feed Pump.

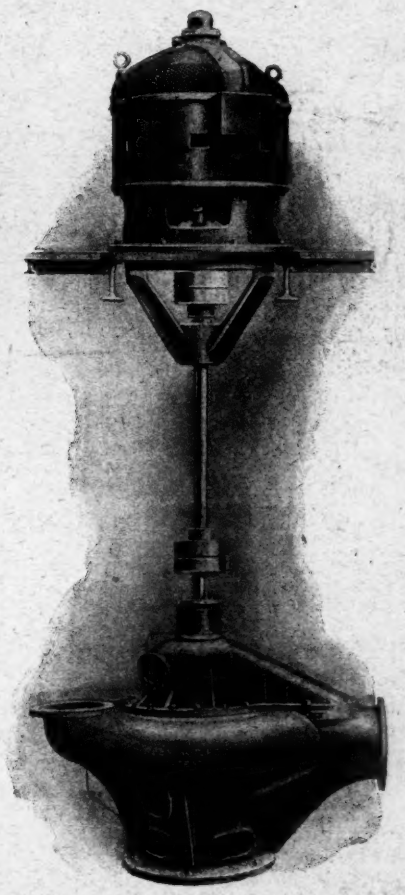


Fig. 6.—150-B.H.P. Roturbo Sewage Pump.

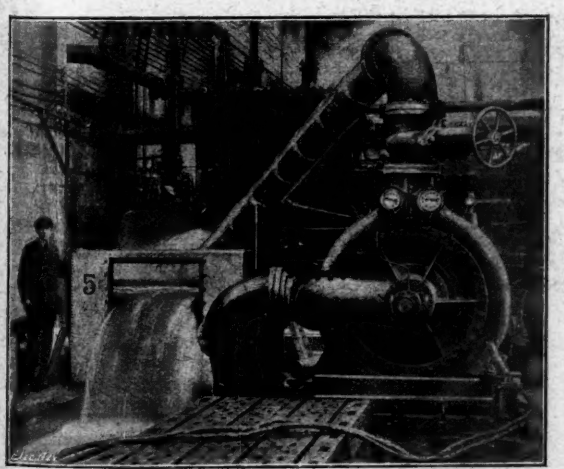


Fig. 4.—Low-speed Rees Roturbo Pump.

enable the pump to be designed for a high lift on a single impeller, and the fluid friction on the impeller, although 25 in. in diameter, was a small proportion of the total power absorbed by the pump.

The duty of the pump is 150 ft. lift, 132,000 gallons an hour, when running at a speed of 925 R.P.M. The impeller is 25 in. diameter, and the diameter of the pipe, 12 in.

The actual efficiency tested under stringent contract conditions was 75 per cent. from *electrical* H.P. to water H.P. at the normal duty, giving an efficiency of 84 per cent. from *brake* H.P. to water H.P. The curves of the performance of this pump, shown in fig. 5, are typical of the Roturbo design.

Starting from the specified duty point—namely, 132,000 gallons and 150 ft. head, the power is reduced from 120 H.P. to 54 H.P. as the water is cut off (by screwing down the valve), but to the right of the curve, where the valve is opened so as to reduce the head against which the pump is working, the volume of water is increased to 200 per cent. of the normal, showing that there is no throttling in the pump, and no reduction of capacity.

The characteristic of the pump is shown in the power curve, which, instead of rising at the lower heads, is actually reduced from 135 H.P. to 105 H.P., due to the turbine effect of the impeller.

The last two figures (6 and 7) show a 150-B.H.P. vertical-spindle sewage pump, one of four pumps supplied to the sewage outfall pumping station at Trowse, Norwich. The particular pump is driven by a 440-volt electric motor, as shown, and is arranged for automatic starting and stopping during the night. Each pump has a capacity of 2,800

gallons per minute at a maximum total head (including friction) of 117 ft., and is designed to deal with a variation of head from 117 ft. to 94 ft., the volume of water increasing inversely as the head.

The guaranteed normal efficiency of the pumps was 70 per cent., but an efficiency of 78 per cent. was obtained at the makers' works.

Fig. 6 shows pump and motor complete, and fig. 7 shows the pump with the cover removed and pressure chamber lifted.

Having once secured the high efficiency and the self-regulation, the modern high-speed prime movers in the shape

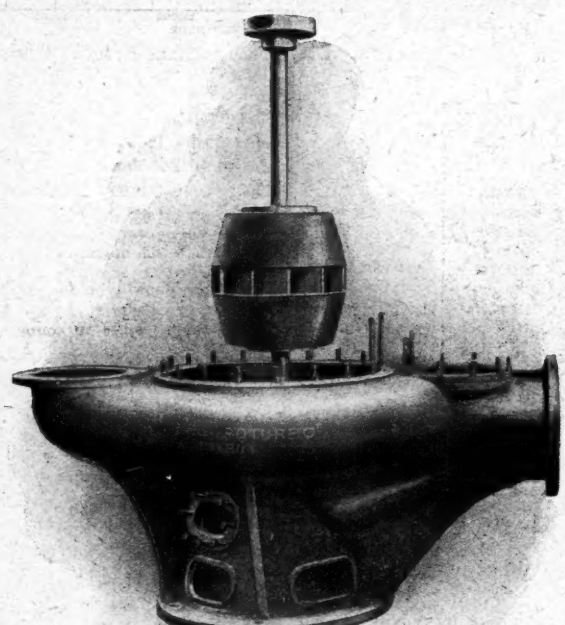


Fig. 7.—Sewage Pump, with Impeller Raised.

of electric motors and petrol engines remove the limitations of the centrifugal pump entirely, and our present illustrations show that there are few conditions of pumping which the modern centrifugal is not perfectly fitted for.

SOME RAMBLING NOTES FROM INDIA.

[COMMUNICATED.]

It is refreshing to see the Electrical Review trying to awaken home interest in trade matters abroad, and as its columns always welcome notes from contributors in temporary or permanent exile, a few random remarks will be jotted down here.

Where electric supply companies are at work—and that is in a very small sprinkling of large towns only—the metal lamp has been welcomed, and more light rather than less metered energy has been the order of the day. But what we want is *cheaper wiring*. One of your contemporaries, in an endeavour to realise Sir W. Preece's ideal of "the poor man's light," tells us that the cost of wiring in England is now 15s. a point, and that it wishes to bring it down to 7s. 6d. I wonder if the firms who export wiring material to India realise that we have to pay often £2 a point for good wiring in teak casing without fittings; that no endeavour is made to introduce, much less to push, any of the cheaper systems (except in the case of Continental firms and their wares); and that, even so, we reckon depreciation on wiring at about 8 per cent. Of course there are reasons to account for some of this excessive cost, of which the most potent is the high cost of European or even Eurasian supervision compared with a foreman wireman's wages; but when all is said and done £2 a point is a very heavy price to pay where electricity has to compete with kerosene oil, even though climate favours the more expensive illuminant.

Most of the business done here concerns private plant, largely in native states, with some street lighting thrown in occasionally. The Presidency towns have their public supply and their tramway companies, some of which are doing very well. There seems to be no wild rush, however, in the smaller towns. It was hoped in 1903 that the legislation then undertaken would encourage enterprise in this direction, and some few companies were floated for this purpose. They have not turned out gold mines, however, and things are more or less at a standstill. Fresh legislation is now being ground in the Government mill, chiefly with a view to bulk supply, but the question is, where are the *distributors* to come from? British capital shows a distinct distrust of the situation with or without a "purchase clause."

Water-power, as you have lately remarked, has great latent possibilities, but they remain latent for the most part; otherwise there would hardly have been references in the Review (p. 621) to the *great* Simla hydro-electric scheme. The whole project amounts to under 1,000 H.P., and it had already been discussed for a matter of 10 years before it began to take practical shape! *Parturiunt montes* exactly fits the case. The rival hill station of Mussoorie has not been without its troubles. No sooner had the undertaking there begun to deliver power, than an unprecedented fall of rain washed away a considerable length of the pipe line; and when the interrupted supply was resumed, an unfortunate misunderstanding caused several deaths from contact with the 6,000-volt lines.

Our railways are, at least so far as mail trains are concerned, improving their rolling stock greatly. Stone's system seems to have almost a monopoly, despite a constructional drawback inherent in the slipping belt; but it works well. Osram lamps, 25-volt, are displacing carbon filaments successfully, and fans are fixed in many first-class carriages. What this means in the hot weather is beyond the ken of Pagett, M.P., and his kindred.

For some years past wireless telegraphy has been used for communicating with the Andaman Islands, mainly in connection with the meteorological reports, and now we have entered the ship-to-shore stage with the arrival at Bombay of the first P. and O. steamer so fitted up. As the system extends, it should prove of incalculable value in the forecasting of the monsoons, on which the prosperity of the country depends. It will also give more timely warning of the approach of cyclones, of which unwelcome visitors Eastern Bengal has lately had experience.

The recent magnetic storm completely stopped telegraphic working on some of the longer lines, which are said to have been charged to 300 and 400 volts—some of them, as the local paper's reporter in the old days said, "weighing several pounds." A present-day reporter on this storm remarked on the extensive display of "aurora borealis" in the southern hemisphere!

Prof. Fleming hopes for great things from a direct solar engine yet to be invented. From what one reads of the late summer weather in the old country, that engine will have to be used mainly for conversion straight back into heat, on the lines of the man who wanted to fill his turbine reservoir from the tail race, with an electric pump. However, if any experimenter wishes to get undiluted sunlight, we can supply him here; the cold water runs out of my tap at 160° F., after passing through pipes on the roof which were not originally intended to act as superheaters. A sun-worked "Therol" water-heater might, with a little trouble and a lot of lagging, be evolved for the service of the morning tub; but it would not help one's load factor.

Let us be serious once more. In general it is our custom abroad to grumble at the manufacturer. Sometimes he makes a note of it, and matters improve. I rather think it is the local firm's turn now. In Indian commercial centres we have old-established firms who act as managing agents for scores of companies—tea, jute, shipping, and what not—and who have engineering departments. They also have home branches, consisting generally of partners who have retired from India. But beyond a certain amount of advertising in newspapers, there is nothing in the way of publicity. If inquiry is made about new devices that have been described in the home papers, it is long odds against them otherwise than on a special order. Recently I was told of an

engineer who, in a private note to a friend in the metal lamp industry, suggested that samples of certain new lamps might advantageously be sent out, as other types were being well taken up. He sent out a few hundred to a local firm, who promptly called upon my informant to take them over and "get them off their books." That does not seem the best way to introduce new goods. I think that a recent contributor in your paper, in discussing Australian matters, hit the nail on the head when he suggested that general merchants dealing in all sorts of commodities are not the best people to take up engineering work. Another very common complaint against contractors is that it takes so long to get a job finished off. No doubt the great distances to be travelled, and the time it takes to get goods from England, are influences that tell here; but it is irritating when a contract is practically complete to have to wait for a lot of small odds and ends to be supplied.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Single-Phase Motors.

I was very much interested in the article in your issue of September 17th, 1909, on the "Single-phase Motor" and, in common probably, with many other readers, I should be glad of more information with regard to the suitability of single-phase motors for ordinary engineering and other similar works.

With respect to one point in the article mentioned above, would not the high periodicity of the original single-phase stations (generally 100 cycles I believe) have been a considerable drawback to the use of motors?

Taking a works in which are installed hoists, centrifugal pumps, fans, &c., driven by direct-coupled motors, would the writer of the article, in the case of such a works, advise single-phase in preference to direct-current working, the size of the works, and other considerations causing a voltage of, say, 100 volts only to be decided upon? This is an imaginary case, but I am acquainted with several fairly extensive works in which D.C. dynamos, supplying current at 110-120 volts, are installed, and in the case of a single-phase installation the alternators would generate at the low voltage also, I presume?

How would the single-phase motor compare with the D.C. motor with respect to convenience in reversing and in regulating the speed? I have in mind D.C. motors with commutating poles direct coupled to blowers and fans and regulated by means of shunt resistances.

In the case of, say, a 100-volt 80 B.H.P. motor direct coupled to a centrifugal pump, could this be started up as conveniently as a D.C. motor and without taking an abnormal starting current?

Although, generally speaking, the D.C. motor as designed and manufactured nowadays leaves little to be desired, I have frequently found it very difficult, in dirty and dusty situations, to keep the brushes and commutators in order and also the starters, and in any case the renewal of brushes is an ever present nuisance, hence it seems to me that if single-phase motors can be relied upon to start up without trouble in such cases as mentioned above, there should be a very large field open to them in the future, and I should be interested to hear the opinion of the writer of the article referred to on this further application of single-phase working.

Advocate.

Straits Settlements,
October 20th, 1909.

In reply to "Advocate" my article referred principally to undertakings in which single-phase plant is, or was installed, and to the fact that the single-phase stations of this country have not progressed with motor loads as have similar undertakings abroad.

This is due to the general belief among engineers that the single-phase motor is unsatisfactory. They scrapped single-phase plant and replaced it by D.C. or three-phase; and the undertakings supplying single-phase current for lighting and D.C. for power, often with separate generating sets, and necessarily with separate systems of mains, give general confirmation to the unfortunate bias against the single-phase motor, for such radical alteration or expenditure would not have been embarked on, had single-phase working been regarded as hopeful. These changes in some cases might have been justified, say, in the case where the single-phase units where small or more or less obsolete, so far as the generating station was concerned, but there is the often greater expense of relaying or adding a completely new system of mains, and if three-phase is adopted, transformers, &c.

Periodicities of 100, which were common till 1900, did, to some extent, retard the adoption of the single-phase motor, but now quite satisfactory single-phase motors for periodicities higher than 100, can be obtained. The difficulty appears to have been rather a matter of design and due to the comparatively poor quality of sheet-iron then available; the latter undoubtedly did affect the development.

For an engineering works such as "Advocate" mentions, it is probable that, unless great and lengthy speed variation were required, three-phase working would give the most satisfactory results, both from a capital cost and operating point of view. If, however, great speed variations over lengthy periods were necessary, and assuming that the motors were used in dusty places, and were not required to give a starting torque of over 50 per cent. of full-load torque, single-phase would give most economical operation.

This case, taken generally, would not lend itself favourably to single-phase working, as its chief points—simplicity in distribution, great flexibility, and absence of out-of-balance loads—would hardly need to be considered, as they would on a mixed system of lighting and power, with varied irregular demands, such as obtains in supply undertakings, D.C. working, in the writer's opinion, occupies a second and third place in the above cases respectively.

These can and must be judged on their merits, with consideration to requirements, class of labour available, and other local conditions that may affect the case. With, say, a fairly modern single-phase generating plant existing, single-phase working should be adopted.

Single-phase induction motors compare favourably with D.C. or three-phase motors in reversing, and can be obtained giving 50 per cent. full-load torque at starting, with 150 per cent. full-load current. This torque is sufficient for the operation of fans, blowers and centrifugal pumps, provided the latter are not working submerged. This class of motor has, in the writer's experience, been used for such severe work as punching and shearing for a number of years, equalling in performance either D.C. or three-phase motors.

Where high starting torques are necessary, recourse must be had to the commutator induction type of motor, and, as already mentioned, this motor will deal with starting torque up to 400 per cent. of the normal. The maintenance and renewal of brushes is practically nil, as these are subject to misuse only during the period of starting; but such motors are not suitable for very dirty or dusty situations.

A. O. Buckingham.

Some Business Anomalies.

Among the many diverse items which go to the formation of the ordinary technical journal, none is more interesting to the layman who cannot enter into the fearsome intricacies of a long-drawn out academic discussion upon this or that theory, than the pages devoted to "Contracts Open and Closed."

A regular, even although somewhat cursory, examination of the contents of these pages will reveal to the searcher after truth, one or two problems of more importance to any firm than the existence or non-existence of a certain factor in an imaginary equation. One or two of these the writer begs to submit to the consideration of kindred spirits, in the hope that some one wiser than he will be able to unravel the mysteries here pointed out.

One often sees in the lists of tendering firms the names of firms quoting for material which they do not make, and such firms not infrequently are favoured with the magic word "accepted" tacked on in the usual place. Such firms are not always merely "merchants," so this does not explain

their quoting, and their only title to being able to quote seems to be that they are something "electrical." Nor, as might be supposed with reason, is the material which they propose to supply always foreign. Here is a case in point. A large undertaking invite tenders for various supplies, and two firms (A and B) are in the running when tenders are opened. A is a well-known firm of undeniable repute and standing, and they can supply the material direct from their own works. B, on the other hand, cannot make this material. Their offer, however, is a little lower; they are asked to give a guarantee that the stuff shall be British made, and doing so they obtain the order. It is not clear how this can be done, but that it is done regularly is beyond doubt.

Another matter which more directly concerns the consumer is also of a somewhat similar nature, and can also be best illustrated by example. A colliery manager, say, requires some electrical goods for his installation, and orders them from a local firm of contractors. The contractors ask a general electrical manufacturing firm to supply the material, but this firm does not make it. In their turn they have to order the goods from the maker, who specialises in such. Four parties in one transaction. The goods go direct under plain label to the consumer from the works where they are made. How do all three make a profit, and what about the consumer's buying ability? Of what use are the technical journals to such a buyer?

The above instances are examples of cases which occur often enough, and the questions suggested in both cases seriously affect equally the manufacturer and consumer.

G.

Protection in Natal.

It is most satisfactory to me to note the strong lead you are giving to Free Traders, not only in England, but in the more distant parts of our Empire, where your journal is extensively perused.

In this particular portion of it we are experiencing the way in which Protection defeats its own ends by increasing the cost of living and of production to such a degree that duties have to be continually raised, not only with a view to establish new industries, but to keep alive those which are already precariously struggling.

I think that an impartial report, following an examination into the effects of Protection in Natal, would be a most convincing document to those whose aim is the common good. Can every Protectionist lay his hand on his heart and swear that he can lay claim to be included in this category? I believe that the ELECTRICAL REVIEW does not subordinate the interests of our beloved country to those of even the electrical engineering profession, and that is why it will be likely to flourish wherever an Englishman makes his home.

J. R.

Durban, Natal, *October 22nd*, 1909.

Protection of Tramway Trolley Standards.

I have been interested in seeing in your journal a copy of the Board of Trade's circular letter with regard to the better protection of tramway trolley standards.

I have been endeavouring to reason out how the suggestions contained in their letter would have prevented the recent death to a man travelling on the top deck of one of the cars on the Wolverhampton and District Tramways. His body and feet were making direct connection between the earthed handrailing and the live trolley standard, and he was found by the conductor in this position, dead.

If the magnetic blow-out fuse had been in use, the standard would have been connected to earth, and therefore at earth potential, previous to the leakage occurring; but immediately the latter happens, the earth is removed and it becomes dangerous. Such a device seems, therefore, to remove the safety earthing just at a time when it is required for protection of life.

The man who was killed would, therefore, have received the shock just the same, and he would be under its influence until the conductor had heard the signal and had time to pull the trolley from the wire. If the car was a full one, with possibly passengers in the gangways or on the platform, and the conductor was engaged in issuing fares, it is quite conceivable that an appreciable period of time would elapse before he could get to his trolley rope. This interval, during which the passenger is subjected to the shock, might easily be sufficient to cause death or serious injury.

It is also suggested that, until better provision is made for the protection of trolley standards, the ruby lamps at present in use should be bridged with a suitable fuse. I cannot quite see where any advantage would be gained, as, in the event of the trolley standard becoming alive, the fuse would blow, and the car attendants would be dependent upon the ruby lamps for any warning of danger, in exactly the same way as they are at present.

It would seem that the only really safe method to adopt is to follow the first recommendation of the Board of Trade—*e.g.*, "To electrically connect the trolley standard to the wheels of the car in such a manner *as to prevent the possibility of the standard becoming electrically charged.*"

From the present circular letter of the Board of Trade, it would seem desirable to combine this method with an audible signal, so that the attendants may know which car is earthing the system.

Inquirer.

A Question on Load Factor.

It will make matters quite clear to "Ratio" if he will look upon the battery as a device for securing economy, just as he would an economiser or condenser. After all, is not fuel saving one of the principal functions of a battery? It enables generating sets to be shut down when they would otherwise be running at so small a load as to be inefficient. Of course the battery may also (and in this case no doubt does) save labour by reducing the number of shifts; and it may also render less generating plant necessary by helping to take the peaks. There is, however, I contend, no reason to treat the battery as anything else than a piece of apparatus for the more economical running of a station. A mechanical stoker saves labour, though not by saving a shift, and the saving in capital cost has its counterpart in the condenser, the absence of which would, in theory at any rate increase the capital expenditure on boilers.

J. S.

Voltages for Country House Installations.

In reply to the remarks of Mr. P. W. Doell, I think there are three voltages desirable for ordinary purposes in small town or village lighting, and the system which will provide all of them is the best possible.

For motors, 500 volts is now becoming a standard, and it is, perhaps, as good as any other. For arc lamps, 80 volts, or thereabouts, will give the best results; and for incandescent lighting, 25 volts is, in my opinion, the best possible.

This, of course, may be varied; I would go much lower for small houses, and others would go higher for large ones.

I would not mind going to 80 volts if I had to deal with both arc and incandescent lamps run from the same supply; but to find any voltage which will give satisfactory results with metallic lamps and motors is, in my opinion, impossible, and they must be kept separate.

As regards arc lamps in series—this is a point which is important—there are several instances quite near here, where single lamps have been fixed, and nearly as many where they have been taken down again.

They were not used to light shops, or goods for sale, but as advertisements only; one was over a public-house door, another was over a pawnshop. It is by no means a pleasant job to explain that one lamp alone is wasteful, and that two or three will not take more current than one.

An average man is not favourably impressed by ifs and buts, and would prefer to have the thing he asks for to any explanations by electricians who, for anything he knows, are not playing the game fairly. Gas men can do these things—they do not need to fix two or three lights to get economical results—and neither should we.

I believe that it would pay many of the supply companies to return at once to low voltage.

I believe my own scheme will meet all the requirements which have to be met now, supplying the voltage most suit-

able for the different requirements. I am sorry I am not quite ready to explain it fully, but I may say that for the instance Mr. Doell gives—800 lamps—requiring under present conditions, 512 amperes, I would not use any larger cable than 7/16, nor have any heavier current than 25 amperes.

I intend to ask the editors shortly to send someone to see what I am trying to do, and to publish an account of it if they think it is sufficiently interesting for them to do so.

Every week they publish accounts of lighting orders being revoked, always on account of the cost being too great for the revenue likely to be obtained if carried out.

If this cost could be reduced 50 per cent., and if the running costs could be reduced another 50 per cent., things might be altogether different.

J. Jackson.

London, N.W., *November 23rd*, 1909.

I think we are most of us agreed on the following :—

Advantages of a 25-volt circuit :—

1. Wires of a very low grade of insulation can be used, such as 300-megohm, this would cheapen the otherwise increased cost of copper, provided runs not long.

2. The low pressure of such an installation lends itself admirably to the employment of the various "cheap-wiring" systems now on the market.

3. Low candle-powers (down to 4-C.P. tungsten and 5-C.P. tantalum) can be successfully used in candle-fittings, night-lights, and corridors.

4. Greater efficiency and cheapness of lamps.

Disadvantages :—

1. *Extremely* difficult to obtain fans, small motors, or heating apparatus ; and even if obtainable, they would take excessive currents.

2. Large drop over long runs ; the 25-volt circuit is not advisable for straggling houses, churches and warehouses.

3. No arcs or lamps of higher candle-power than 32, can be obtained.

Of course, circumstances (such as the compactness of the building) alter cases, but to save complication, I would strongly advise two standard voltages for country-house work, 25 volts up to 150 lamps, and 110 volts beyond ; 110 volts should be standard for churches and warehouses, where runs are long, and power or high candle-power lamps are required ; 110 volts has been standard for so many years, that it is easy to obtain arcs, motors or heating apparatus. I know no reasons for adopting 65 volts ; it has none of the advantages of the 25-volt supply, with most of the disadvantages of the 110-volt, so far as regards fire-risk, low C.P. lamps, &c. With regard to cheap wiring methods for 25 volts, in two installations recently erected in a small church and house—Glaslough, Co. Monaghan, Ireland—3/20 S.W.G. and 3/22 S.W.G. lead-covered 400-megohm wire was found to be highly successful—using, of course, continuity fixtures. All lamps were of the tungsten type, except portable standards, where tantalums were used, being less fragile.

I would add that the lead-covered wire was attached to the wainscot, and painted to match—excepting in sitting rooms, where it was buried in the plaster. As to 4, 8 or 16-volt circuits, they are in the nature of toy installations, and could scarcely be employed for more than a dozen lamps.

Seymour Leslie.

London, W.

[Our correspondents show a tendency to digress from country-house lighting to warehouses, pawn-shops, &c. ; the subject proper is of considerable interest, and is essentially distinct from any question connected with electricity supply from public mains.—EDS. E.R.]

Electric Lighting for Villages.

Your article in the REVIEW of October 1st, on engineers "At Home and Abroad," has suggested to me the advisability of submitting to you or to your readers a problem which I have been considering lately.

You have described and illustrated in the REVIEW a great many large electrical schemes and plants for power supply, lighting, and other purposes, but one looks in vain for any particulars of small plants for lighting and power such as would be suitable for the lighting of small towns and villages, especially for villages in these colonies where the conditions are considerably different from those of home villages.

To explain the problem I put, I shall give the particulars of a proposal which has been under consideration here, and which is to some extent typical of several other cases.

A village of, say, 60 to 70 houses, compactly situated on an approximately square area.

Water-power available near one side, the distance from the power station round the village and back to the station making a circuit of about 8,000 ft.

Two methods of carrying out the lighting of this place have been suggested, one proposal is to use direct-current dynamo, charging, say, 15 sets of accumulators in series ; each accumulator set supplying a small group of three or four houses, and having a maximum output of, say, 500 or 600 watts.

The other proposal is to use an alternating dynamo with transformers similarly arranged to supply the small groups of houses.

In either case the most efficient metallic-filament lamps would be used, arranged for, say, 25 volts.

There would be advantages and disadvantages in each case, and the problem is to find which has the outweighing advantages.

I would point out that, to suit the conditions here, the first cost must be as low as possible, and therefore everything should be arranged of the plainest and simplest kind consistent with due efficiency ; and that a strong point in favour of the accumulator system, for a small plant of the kind proposed, would be the saving of an attendant at night, the cost of whom would be a high proportionate item in a small plant.

A result distinctly in favour of either system will ease the path of

An Engineer Abroad.

October 20th, 1909.

[Various village installations have been described in recent years in our columns ; apparently our correspondent has overlooked them.—EDS. E.R.]

The "Steady Job."

Referring to the article which appeared in your journal last week under the initials "A. P. C." sub-titled "A Minor Philosophy," I would like to say I have seldom seen a sillier sham printed in any journal. A much more suitable title to my mind would have been "A Pseudo-Philosophy." The whole article teems with illogicalities and misstatements.

It is apparent that the argument of the survival of the fittest cannot and never could apply to our present business system until it is so drastically altered that *equality of opportunity* is given to every individual. But your contributor openly advocates the former principle, assuming that the best men will come to the top, regardless of the fact that the best men in many cases may have started so handicapped that it is next to impossible to rise at all. His remark "if a man does not personally gain by any deed of his own he will not take the trouble to do it," is a downright slander on all the greatest writers, inventors and artists of all time. It is often truer that the inventor receives meagre advantage from his inventions, and long after he has ceased to receive any interest whatever from them they continue to swell the fortunes of shareholders who, whatever else they possess, never had a spark of inventive genius. How does your contributor account for the fact that such great inventors as Edison, long after they have accumulated more money than they could ever spend, continue to invent ?

Again, his remark that "the wonderful advance of the United States people . . . . is due to the uncertainty of tenure of position," is of all bosh the most utter. A country gifted with natural resources and opportunities such as no other country is, increases its trade and rises to be a great nation, and he explains it with a piece of flabby philosophy about uncertainty of tenure. Rather would it be cause for wonder if such a nation did not advance with advantages such as this particular nation has.

It is quite clear from his next point that he thinks we should imitate the example of the American. He says : "The American has been brought to learn that specialisa-

tion is valueless . . . . therefore he becomes self-reliant and afraid to tackle nothing." Yes, I know such. You can see them every day in England, America and everywhere else; they are mostly semi-engineer-travellers, who, when they meet something of which they know less than nothing, shut up and try to look intelligent. Such people usually end by getting themselves and their firms into such a mess that it takes the quiet calculating man to unravel them.

I contend, and challenge your contributor to prove otherwise on any moral grounds, that when a man has reached middle age, has a wife and the privilege of moulding and forming the minds of his children, that it is not right or even necessary he should dash about with hare-brained schemes for worsting his business rival. What your contributor calls the survival of the fittest means the *survival of the unscrupulous*.

He asks "Why is France a decadent nation?" and then proceeds to answer himself by explaining it is entirely due to the French mothers having a longing for permanent positions for their offspring. This is almost laughable. He contends that a nation loses its stamina and becomes decadent because its people have succeeded in "pulling together" instead of turning the country into a bear garden of conflicting small-souled business fiends, each with a great idea of his own powers and determination to worst everyone who comes in his way.

Again, supermen are not produced by industrial competition, and they never have been, but by *intellectual competition*, and the two are as far apart as the poles.

As I have said, when a man has reached middle age, it is his time to enjoy, as far as he can, what is left of his life. What is the earth for? To turn into a great murky industrial battlefield with ineffaceable signs all around of the crushed out and the maimed to nauseate and embitter those on top? Or is it not rather for the use and enjoyment of all its inhabitants? Are the great inventions, electricity and others, here simply to be exploited for the profit of one or two shareholders, or to make the lot of man easier?

Is the world as a whole better because some of its inhabitants, with a preponderance of brain power, think it good to fight and shriek and scramble in their efforts, usually to pile up profit for someone else? I can name a host of world's greatest engineers, artists and inventors who have died poor, whose genius was, in some cases, only recognised after their death, who would undoubtedly have been crushed out in the struggle your contributor eulogises—men whose names and works will live long after the last sweater-hustler's name has ceased to be remembered.

A. C. Circuit.

A Correction.

Your report in last week's issue of the REVIEW will cause our friends and ourselves needless pain and loss, and although we do not propose to discuss in your technical paper the details of a sordid trade dispute, we trust you will allow us to state two facts.

1. We were not able to instruct or appear to answer the claim, owing to enforced absence caused by serious illness.

2. The statements made by a Mr. Truman—a person whom we do not know that we have ever met—had really nothing to do with the issue which had to be tried, and are wholly untrue, having no foundation whatever in fact.

J. E. Wakelin & Co.

Institution Proceedings.

We shall all owe you a debt of gratitude if, by taking up this matter as you have, you can bring to an end the present practice of authors reading their papers in full at the Institution meetings.

Too often have we had to sit patiently in a crowded chamber, whilst the author has, I was about to say, gabbled through his paper in a tone which would seem to betoken a total lack of interest in its matter, and a desire only to get to the end of it.

After an hour or more of this when most people are already somewhat bored of the proceedings and anxious to escape, we are allowed a few minutes only for the only really interesting part of the proceedings, viz., the discussion.

What is the result? At the most, a very few members can take part in it, and those others who might wish to offer or obtain information on the subject under discussion must do so afterwards, informally over a cup of coffee.

Surely this is not the way to make the proceedings of the Institution interesting or instructive?

It is high time that the old system was done away with and reforms instituted on the lines suggested in your leading article.

M. Farrer.

Electricity Works, Twickenham,
November 19th, 1909.

Your leading article advocating that printed papers should be sent in advance to every member, and that discussion should proceed without wasting time in reading a technical paper to the meeting, will be heartily endorsed by everyone who desires that engineering societies should be really useful.

I would like to make another practical suggestion, viz., that those members who cannot express their views without recourse to formulæ and diagrams should send their views in writing "for interment in the Society's *Journal*," and so leave the discussion open for those who can put their spoken views into plain English.

Practising engineers who want mathematical instruction can attend classes, or consult text-books; but they do not want discussion obscured by masses of figures and formulæ, hastily written up on a distant blackboard.

Scrutator.

PROCEEDINGS OF INSTITUTIONS.

The Electric Ignition of Internal Combustion Engines.

By JOHN W. WARR, A.M.I.E.E.

(*Abstract of paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS, *Manchester, November, 2nd*, 1909.)

IN whatever form it is applied, electric ignition is a notable advance on what previously existed. It provides absolute immunity against fire, the spark is well suited to the explosive mixture, and charges which are so weak as to give irregular impulses with the hot tube, can be fired with absolute certainty. Further, an increased efficiency is obtained by being able to fire

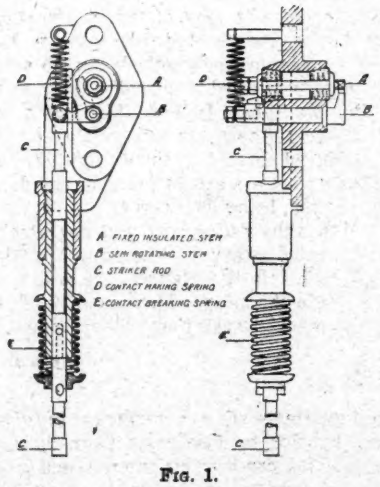


FIG. 1.

the charge at the moment of maximum compression, it admits of automatic timing and consumption of current and the use of higher compressions.

The electrical ignition of all modern automobiles is produced from either a primary or a secondary current. The primary current is, of course, a low-tension one, and the devices that can be used may be tabulated as follows:—

1. Accumulator. 2. Accumulator and series coil. 3. Magneto.

The hot-wire system, which is named "Catalytic Ignition," has never been put into commercial operation.

The accumulator alone with a pressure of 4 to 6 volts appears to be one of the very earliest devices, but owing to the large current taken on short circuit, the ignition points were quickly destroyed

and the high temperature of the points set up by the large current frequently caused premature ignition.

Later the accumulator and series coil was introduced, the presence of self-inductance or extra current making its appearance as a bright hot spark at the tappet points at the moment of breaking circuit.

The low-tension magneto driven from the cam shaft was rapidly brought forward, perhaps on account of the necessary recharging of accumulators and their other attendant evils.

Contrary to the high-tension system, all low-tension ignition has to be operated with mechanical make and break tappets from the cam shaft. The gear shown in fig. 1 is representative in principle of those used by leading builders and is attached vertically to the

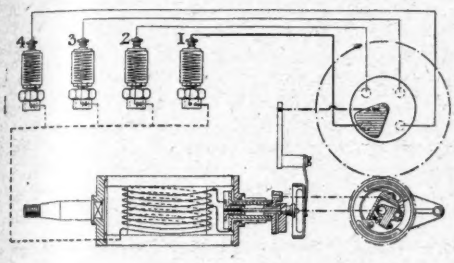


FIG. 2.

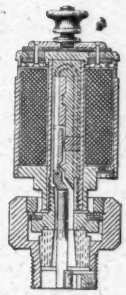


FIG. 3.

sides of the cylinder. The fixed insulated plug is shown at A. The tappet B is also fitted into the plate to rotate through a small arc, both A and B projecting into the combustion chamber. With the striker rod C in the normal position, the spring E keeps the contacts apart internally. Shortly before ignition takes place the cam raises the rod C through an intermediate pusher rod, and allows the spring D to bring the internal contacts together. A step in the cam then passes the foot of the pusher rod, and allows rod C to fall quickly, due to the influence of spring E. The momentary making of the circuit is at once followed by a quick break, thus producing a spark at A and B. Provision is made for retarding or advancing ignition when desired, the operation being controlled from the steering pillar.

In order to dispense with complicated mechanical striking gear and tappets, magnetic plugs or electrical tappets are used. The plug and diagram of connections is shown in fig. 2. A section of the plug is shown in fig. 3. The current is generated in the two windings of the revolving armature from the permanent field, and attains a maximum voltage twice during each revolution, the two maximums being 180° apart and producing two sparks per revolution. The armature is driven at crankshaft speed. In the diagram of connections the dotted lines represent the circuit completed by the car frame. On the right-hand side of the armature is shown the contact breaker through which the auxiliary winding is

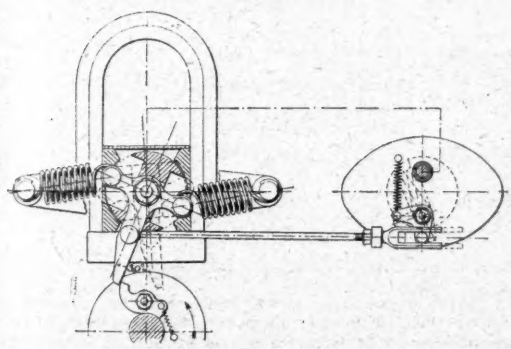


FIG. 4.

periodically short-circuited just previous to the current attaining its maximum. At the moment of short circuit a sufficient current in the main winding to attract the plug interrupter is not produced. However, when sparking is to take place within the compression space of the cylinder, the platinum points of the contact breaker are severed, the current in the main winding being suddenly reinforced by the extra current of the auxiliary winding. Thus a powerful current flows through the coil of the magnetic plug by way of the distributor, vigorously attracting the armature interrupter of the plug and effecting a quick breaking of the contacts. This in turn produces a powerful and very hot spark in the same way as the mechanical tappets. The variation in timing is effected by rotating the lever embracing the make and break contacts shown on the right-hand side of the drawing, directly below the distributor. By this means the interruption and the spark are produced earlier or later. For a four-cylinder engine the rotation of the lever is about 50° on the crankshaft. The engine is stopped by short-circuiting the armature to the frame through a single-pole switch.

There is just one other low-tension magneto igniter that is used chiefly with single-cylinder engines. The current is produced by an oscillating motion of the armature, which is moved out of its position of rest through an angle of 30°, a thumb on the cam shaft striking the trip lever on the armature shaft. The horizontal springs bring the armature into its normal position. The whole arrangement is shown in fig. 4, including the striking rod, which operates the mechanical tappets. The tappets break circuit when the armature has passed a few degrees beyond its normal position. The length of the spark depends largely on the swiftness of the movement of the armature. The variation of ignition is obtained from a device on the cam shaft, so that the releasing of the trip lever takes place early or late as required.

In comparison with the high-tension system the low-tension ignition is not so popular. The objections are: wear of the tappet points and the moving parts within the combustion chamber, wear and tear of striking gear whilst operating at high speeds, and constant need of adjustment, which in many cases can only be perfectly carried out by experts.

The high-tension ignition does not require any of the gear mentioned above, the apparatus used being of such a character as to produce a flaming jump spark between the electrodes of the plug screwed in the combustion chamber. The means used for producing the high-tension spark are:—

1. Battery and induction coil; 2. Magneto and induction coil; 3. High-tension magneto.

The battery and coil ignition is well known. With the modern ignition accumulators we have compactness and fairly large capacities. The celluloid case enables one to see the condition of the plates at any time, and especially during the progress of charging. On the other hand, acid spray and bad joints between the celluloid and the lead terminals have brought them into great disfavour with a large number of motorists, the acid playing havoc with everything that comes in its way. Then we have the question of recharging. But it is doubtful if the accumulator is so black as it is painted.

The primary dry battery has come into great favour lately, and there is no doubt it is being used with satisfactory results. The multiple cell giving an E.M.F. of 6 volts is suggested, with a variable resistance connected in series with the primary of the induction coil and the battery, so that the pressure can be reduced to about 4 volts. When the battery has been used for some time, the E.M.F. falls off; this can be detected by misfiring, and instantly restored by cutting out a small section of the resistance.

Some dry-battery makers recommend multiple-series connections for heavy ignition service on automobiles. The objection to this system of connection will be the weight and accommodation. The author has now used dry batteries for ignition for a considerable time, with most encouraging results.

Induction coils may be divided into two classes, the plain type with primary and secondary winding and condenser, and the trembler type—the same fitted with an external high-speed trembler. Apart from the fact that a multi-cylinder engine cannot be started on the switch with a plain coil, the timing seems to be more exact with a given piston position. A plain coil may be unintentionally left in circuit if the main switch is left closed, which is liable to burn out the coil and exhaust the battery. The trembler coil gives warning when left in circuit.

The best results are obtained when the self-induction of the primary and the capacity of the condenser are balanced, producing resonance. The larger the current passed through the primary (which can be produced by over-screwing the contacts) the greater should be the capacity of the condenser. On the other hand, the gradual burning away of the platinum reduces the current in the primary and produces unbalanced effects with the condenser. Therefore, the desirability of an adjustable condenser seems clearly demonstrated. If the condenser is too small the secondary spark is short and feeble, with incurable sparking at the platinum. If the condenser is too large, the spark is short and fat.

There should be no practical difficulties in the way of turning out every coil perfectly balanced, but until there are better means provided to adjust the contact screw, excessive pitting of the platinum points is bound to take place when handled in ignorance.

The adjustment of a trembler blade apparently requires very great care. When the author was testing a coil some time ago, the ammeter connected in the primary showed that a current of from 1·5 to 6 amperes could be drawn from the 4-volt battery by altering the contact screw, and on closed circuit 15 amperes was indicated. In this instance, how could the motorist say which was the correct current? Both 1·5 and 6 amperes produced sparks that appeared to have equal inflammation capacities. Inexperienced persons adjust their trembler blades by the note that is produced from the rapid vibrations of the armature, a high, shrill note being considered the best. The author has proved that a moving-coil ammeter in the primary of the coil is the only guide, as regards the most effective spark and economical current consumption. The more pressure put on the blade by the screw, the nearer the contacts approach short circuit.

A very light fuse would be a useful addition in the event of the contact screw being lowered too far. This would indicate the presence of too large a current in the primary winding.

After being in use for some time the platinum appears to leave the positive contact and builds up on the negative. A reversing switch would tend to keep the contacts level and do away with the filing of an expensive metal. Of the many faults in connection with ignition coils, internally punctured insulation of the windings and condensers makes up a large percentage. The author is of opinion that a permanently fixed spark-gap would prevent a number of troubles, as the coil is very often operated with the secondary on open circuit by inexperienced persons when endeavouring to locate the causes of misfiring. A good type of trembler is shown in fig. 5.

In either type of coil it is of the utmost importance to have an iron wire core that will admit of rapid changes of the magnetic flux. Lagging magnetic effects seriously hamper the period of inflammation. For instance, when the engine is running slowly it is possible to get correct ignition at the right position of the piston, but when running at high speeds ignition does not take place when

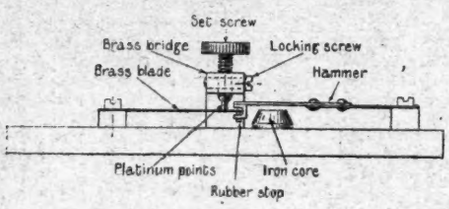


Fig. 5.

expected, evidently due to the time taken to magnetise and demagnetise the core of the coil. With an engine running under practically full impulse, ignition should occur just as the piston starts on the expansion stroke. Without considering any difference in compression pressure, and supposing the period of inflammation is $\frac{1}{120}$ of a second and the engine speed is 600 R.P.M., then $\frac{600 \times 360^\circ}{120 \times 60}$ = 30°, or ignition should take place when the crank has still 30° to turn, *i.e.*, $\frac{1}{12}$ of a revolution or 30° in advance of the dead centre of the piston. From this it is evident that after running at high speeds on the level with the spark correctly advanced, better results will be obtained when mounting a gradient in high gear by retarding the spark because the engine speed is lower.

We now come to the question of distributing the high-tension current in multicylinder engines. With the single cylinder this is effectively carried out by rupturing the primary current with a simple make and break contact on the half-time shaft. A common method is to provide a low-tension rotary wiped roller contact with as many points of rupture as there are cylinders. This type is shown by fig. 6 and makes and breaks circuit at the correct period in the primary circuit of the coils. The high-tension leads from the trembler coils go direct to the plugs. Levers and connecting

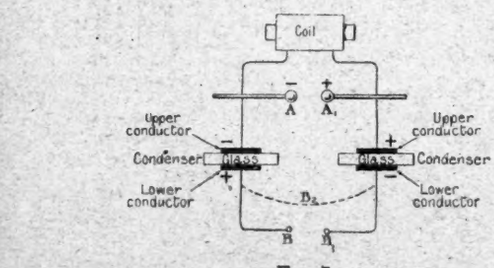


Fig. 7.

rods rotate the fixed contacts through a given arc so as to produce early or late ignition.

Another system consists of a combined low-tension contact maker and high-tension distributor, both being exactly synchronised and timed with the piston. Only one trembler coil is used.

A high-tension battery system can be operated without trembler coils. As most of the troubles arise from the tremblers, this method has a great advantage over the others. A make and break contact is fixed to the half-time shaft, and is capable of being moved to vary the timing. A single plain coil is used.

The B spark deserves attention. The diagram, fig. 7, displays the general principle of the igniter. The high-tension current is connected to the plugs through the intervention of two condensers

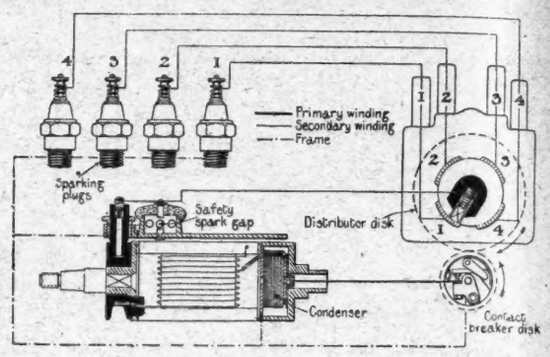


Fig. 8.

with their outer coatings shorted through a leakage path or imperfect conductor, the object of which is to keep them always at the same potential, except at the instant of sudden discharge. No strain is thrown on the plug leads, they remaining at the same potential up to the last moment, when the two condensers are full and overflow at A. At this instant everything is liberated, and with great rapidity the condensers empty themselves across A and round the completed circuit to the sparking plugs and ignite the mixture in the compression space. The high-frequency discharge is so violent that soot round the plug electrodes is flung away, also the spark will blaze through water. An accumulator and induction coil with trembler blades furnishes the high-tension current for the con-

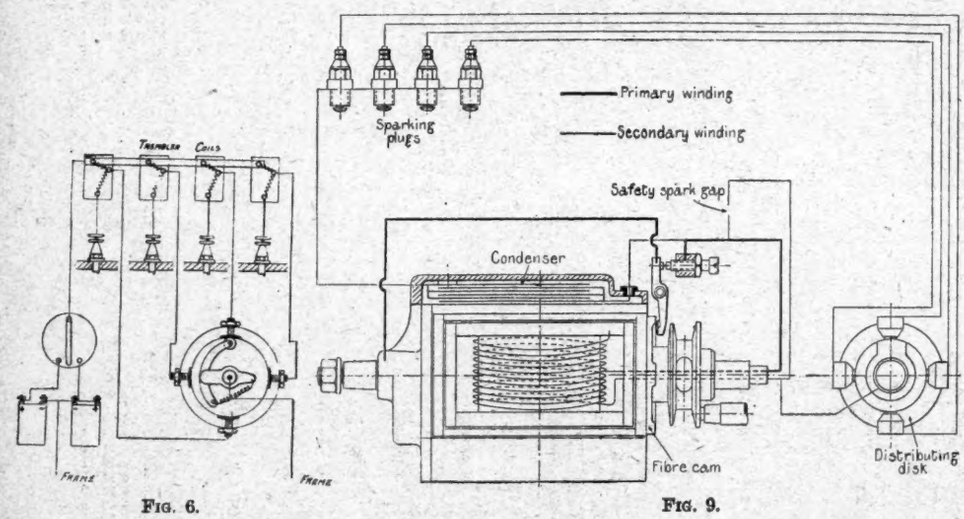


Fig. 6.

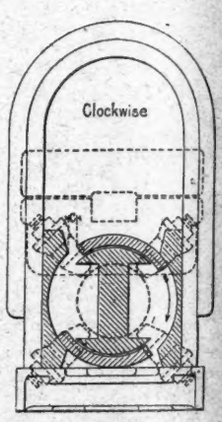


Fig. 9.

densers, and, contrary to usual practice, the secondary winding of the coil is built up in sections. The coil only takes 0·75 ampere for a four-cylinder engine, which is a very small figure compared with other coils. Only one coil is used, the high-tension current being conducted to the cylinders by a high-tension distributor working on the cam shaft. A spark, large in quantity, and thus more effective in inflammation capacity, free from liability to short circuit with dirty plugs, and rapid in application, is undoubtedly obtained. The idea is due to Sir Oliver Lodge.

Probably the most popular form of ignition is the one in which the high-tension current is generated in the winding of a rotating or stationary armature. The diagram of connections in fig. 8 represents a high-tension magneto for a four-cylinder engine. Between the pole-shoes of the permanent magnets rotates a shuttle-wound armature on which are two windings, a primary and a secondary, the latter forming a direct continuation of the primary. The high-tension current is produced in the secondary by short-circuiting and opening the primary circuit through the platinum-pointed contact breaker twice in each revolution. At the moment the circuit is broken the high-tension current is collected from the slip-ring by a carbon brush and taken to the distributor and plugs by the contact brush driven from the armature spindle. The armature is driven at crankshaft speed, so that when the winding is cutting maximum field its position must correspond to a definite position of the piston.

Another type of high-tension magneto, fig. 9, is one in which the generation is based on the same principle as the well-known inductor alternator. The armature winding is stationary and

mounted in the permanent field. A tubular soft-iron inductor envelope, having two slots cut in it, each representing a quarter of its circumference, revolves between the armature and the pole-shoes. By this means the current in the primary will attain its maximum when the inductor has rotated through an angle of 90° or four times per revolution. By rupturing the primary circuit during the effective periods, a current is induced in the secondary winding four times per revolution. As no slip-ring or collector is required, the high-tension current is conducted straight to the brush contact of the distributor disk.

The spark from high-tension machines of this class is more intense than that produced from ordinary induction coils. As an example, the coil spark in one experiment was only justly sufficiently powerful to ignite a mixture of petrol vapour and air in the proportion of 1 to 15, whereas the magneto spark was capable of igniting a mixture of 1 to 19.

Some of the machines have a condenser connected across the make and break, but in all cases spark-gaps are provided. Ball bearings can be fitted if desired, which, needless to say, are infinitely better than the sleeve bearing. Wherever possible gear drive should be used—chain and sprocket wheels severely punish either type of bearing.

The chief advantages of magneto ignition are: an inexhaustable source of current, the induced current is directly utilised, and the sparks have a higher temperature. The vital parts are not scattered in different parts of the car as is the case with the coil and accumulator ignition. With a spare magneto carried in the car the faulty one can be removed in a few minutes. On the other hand, it must be remembered that the magnets require reflashing periodically, bearings and platinum contacts require attention, a perpetual load is always on the engine, and the adjustment in the timing is not so flexible as with the coil.

It is common practice to provide accumulator and coil ignition for starting the engine, afterwards throwing over to the magneto.

A very ingenious device has just been introduced for starting. The principle is based on the temporary use of the primary and secondary winding of the high-tension magneto armature as an induction coil. Current from a dry battery furnishes the current which is conducted by suitable switchgear to the armature primary winding. If the engine has to be started after it has not been working for a few days, a turn of the handle is required to rupture the dry battery current in the primary winding, but if a charge is left in one of the cylinders previous to running, the pressing of a button switch will start the engine whilst the driver is seated. The author is of opinion that energising the armature in this way will in time reduce the field strength of the permanent magnets.

Discussion.

Mr. J. G. Walthew said that for motor-cars the low-tension system had very many advantages, but for the stationary engine the high-tension system was undoubtedly the best, except in the case of single-cylinder engines. Excessive wear on the sparking points was generally due to unequal or bad setting of the contact maker and breaker. The spark in the ignition box should not be more than about $\frac{1}{16}$ in. at the outside in the low-tension system. It was possible to fail to get a spark from the low-tension plug, simply because the small moving contact-maker had a fine coating of dust or dirt, which arrested the electric connection. The trouble with the accumulators was the only weak spot in the high-tension system. He had found that the current necessary with a 6-volt primary circuit varied from about 2 to 3½ amperes, when the trembler blade was working practically the whole time.

Mr. Frith said that he did not think that motorists would consent to a fuse in the battery circuit of their cars, with the possibility of the fuse blowing. He did not think it was right in theory to employ only one coil to ignite a multi-cylinder high-speed engine, as the electromagnetic conditions of the coil could hardly be expected to follow the changes required at sufficient speed. The question of simultaneously firing the charge at more than one point in the cylinder by means of two plugs in series, worked from the same coil or magneto, was engaging the attention of motorists; could the author say if this was worth the extra complication of double-pole plugs, &c., which it involved? And in the simple accumulator and coil system, did it matter at all how long the stream of sparks was allowed to flow after the explosion had actually started?

Mr. R. B. Slacke said that the corrosion of the terminals of accumulators could be stopped with a vaseline cup. Most of the troubles of accumulators were due to under-charging and over-discharging, &c., especially over-discharging. As far as motor-cars were concerned, there was one thing in favour of the accumulator; if the battery ran down they could probably by walking a few miles obtain another one. A spare magneto was valued at something like £10 to £20, whereas a spare battery cost about £2. A system in use for large gas engine work with a voltage from 60 to 100 was practically the same as the low-tension system on a car. It had a mechanical tappet, but this was operated by a solenoid. There were slip-rings on the cam shaft, and as each contact piece made contact with the brush, it closed the circuit, which at the same time closed the solenoid, and also closed the circuit through the tappet, the tappet in its normal position being closed, so that the effect of the solenoid was to open the tappet and shut it again. The tappet itself was of cast-iron, and it did not seem to have given any trouble from wear. Several makers of Continental gas engines used that system. One of two of them had had experience with the Lodge ignition, and in one case that had been adopted in preference to the other, and had been found to be very satisfactory. One did not alter the timing to alter the speed of the engine, but according to the value of the mixture.

Mr. J. M. Atkinson said, with regard to large gas-engine work, one of the great faults with the low-tension system was that one could not get the surfaces of the plug and the contact to exactly line with each other. They would wear to a ridge, giving uneven firing in the cylinder. They arranged to time the ignition for both ends at once, but at one end there might be more wear than at the other. The consequence was that the plugs had to be taken out and filed down. The Lodge system had been used by Messrs. Ehrhardt & Sehmer. Magneto ignition worked very well, but he thought that high-tension ignition was the one that had come to stay.

Mr. Cox said not only the battery but the coils had weak spots. It certainly was an advantage to have a gap on the outside, especially in multiple cylinder engines; it gave them a chance of actually seeing if there was a plug mis-firing due to any external cause.

Mr. Stelling said the author had not emphasised the relative merits of the oscillating and the rotating shuttle in magnetos. Personally, he was in favour of the oscillating shuttle combined with what the author described as an inductor envelope. The great advantage of this envelope when combined with the oscillating system was that there was a very small moving mass, and in consequence there was slight mechanical reaction, whereas with an ordinary wound shuttle oscillating, they were apt to get unnecessary vibrations and broken wires. Another advantage was that they were able to get very accurate timing with the former, and by adjusting the tappet, they were always able to take the current at the top of the wave.

Mr. H. J. Coates said, referring to the practice of placing the high-tension winding over the armature winding, it was questionable whether this really was the best place in which to fix the secondary winding. The difficulties of sound insulation were often considerable, in spite of the limitation of the voltage-rise due to the provision of a protective spark-gap. In some few makes it had been the practice to place the transforming element over the armature box underneath the arch of the magnets; this disposition appeared to be a better one for providing effective insulation and reducing the risk of breakdown. With really good coils and a suitable auto-trembler common to them all, little difficulty should be experienced in running with a current of ½ ampere, and with such a small current there would be very little trouble from pitting contacts.

Mr. Warr, in reply, said he would always prefer high-tension ignition for motor-cars and for stationary engines. The ordinary gas engine driver and the modern chauffeur could not usually diagnose a sickly accumulator, or even recommend a cure, and this was one of the reasons why the dry cell should be encouraged. He advised the use of the dry cell for an ordinary make-and-break contact and the plain coil, but with a trembler coil the cell was subjected to heavy duty, and was quickly exhausted. A reliable cell could now be obtained with high capacity and reasonable weight. A perfectly balanced coil should not take more than ·75 ampere with an E.M.F. of 4 volts. Reflashing the magnets was synonymous to remagnetising the permanent magnets. This was more satisfactorily carried out by constructing a large electromagnet and stroking the poles of the permanent magnet on its face. Remagnetising would probably be required every three or four years. With regard to the type of contact, one that had a combination of the wipe and make-and-break was obtainable. To ascertain the correct position of the contact screw of the trembler blade, the ammeter should be connected up in circuit between one terminal of the two-way switch and the common bar of the coils, shown in fig. 6. The application of the fuse was to be recommended for setting the trembler blades only. As to retarding the spark when climbing a gradient, if one timed the spark to occur when the piston was just starting on the expansion stroke with the engine stationary, the position of the spark would not be the same when running at high speeds on the level; the timing was late, due to the lagging magnetic effects of the coil. Seeing that the engine speed was lower when mounting a gradient, it was better to retard the spark from the position used at high speed. He had tried the vaseline cup round the accumulator terminals, but the acid spray made a mess of them in spite of this precaution. The insulation of the secondary winding was subjected to an enormous electrical stress if the two ends of this winding were on open circuit, and the safety gap which he mentioned as an advantage, was analogous to the relief valve of the steam boiler. Comparing magneto and coil ignition, the magneto was certainly more expensive in initial cost than the coil equipment, but the mechanism was more simple and compact, and the magneto was a more reliable article; there was no doubt that greater power was obtained from the magneto than the coil. The reason for this was that as the speed of the armature increased, the spark produced became larger and hotter, and combustion was commenced and progressed more rapidly.

Institution of Electrical Engineers (Glasgow).

At the opening meeting of the Glasgow Section on November 16th, Mr. E. G. Tidd, chairman, delivered his inaugural address, dealing with the progress of electrical science during the past 25 years. Referring to the Glasgow electricity supply undertaking, he stated that the total capacity of the plant installed was 39,780 H.P., with 16,926 customers, 837 public arc lamps, and 3,853 motors, equalling 23,748 H.P. He believed he was correct in stating that the existing stations were practically filled up. At the present time in Glasgow there were 180½ miles of tramway track, having a total of 13,000 H.P. in the generating plant, besides

auxiliary and exciter plants. Turning to the state of the manufacturing business, Mr. Tidd thought that one of the chief features which had helped the manufacturers to arrive at the present state of perfection, was the introduction by mechanical engineers of electrical departments. This woke up the manufacturers of electrical machinery to the fact that sound mechanical engineering was the foundation of all good electrical machinery. To-day the standardisation and perfection of design in electrical machinery was probably in advance of any other class of engineering. Electric wiring had probably been hampered by undue cutting of prices, more than any other industry, and they could only hope that reputable firms, who did thoroughly honest work, would survive the cutters, and by increased output and better methods, make the business more profitable to themselves, while not increasing the cost to the consumer.

Institution of Electrical Engineers (Newcastle-upon-Tyne).

The subject chosen by Prof. H. Stroud, chairman of the Section, for his inaugural address on Monday last was "Radio-telegraphy," with special reference to the new wireless installation at the Armstrong College. The apparatus provided includes the spark and Poulsen arc sending systems, with means for varying the wave length over a wide range, and corresponding receiving apparatus for Marconi and Poulsen waves. The author stated that the new Telefunken "shock excitation" system, based on Wien's "quenched spark," 1906, had proved a great improvement on the ordinary spark method for the production of electric waves. In the latter, reaction took place between the primary spark circuit, as long as the spark lasted, and the secondary antenna circuit, this reaction resulting in the production of waves of two wave lengths. In the new Telefunken system, advantage was taken of the very large damping of a series of very short sparks. The primary oscillations were "quenched" by this damping after but one or two swings, and the secondary circuit continued to oscillate in a single period, giving rise to an electric wave of definite wave length. An alternator having a frequency of the order of 1,000 per second was used to give, by means of a transformer, a very high number of discharges per second. One of the principal advantages of this system was the musical tone produced in the telephone at the receiving end; this was distinctive of the station transmitting, and very different from the noise of atmospheric disturbances.

In the Lepel system, a very short cooled spark between two flat metal plates, 3 in. in diameter, was used. These plates were separated by paper except at the centre, and the supply voltage was 400-500 volts. The receiver in this system contained two tuned circuits, the aerial and the intermediate, and an aperiodic circuit in which was the detector, of the thermo-electric type.

The problem of directive wireless telegraphy had made considerable advance towards solution by the experiments of Bellini and Tosi, who had constructed a complex antenna, by means of which the waves were sent almost entirely in one direction. Similarly at the receiving antenna they could locate the sending direction.

Experiments with this system were made with satisfactory results last year between Dieppe and Havre, and Dieppe and Barfleur.

LEGAL.

Anderson v. H. P. Saunderson & Co.

In the King's Bench Division on Thursday, November 18th, before Mr. Justice Darling and a special jury, Mr. James Chapman Anderson, of Aikenhead, Blairgowrie, in Perthshire, sued Messrs. H. P. Saunderson & Co., electrical and motor engineers, of the Elstow Works, Bedford, for the recovery of the sum of £280, moneys paid to defendants in respect of the purchase of a 30-B.H.P. "Universal" motor tractor, which plaintiff bought from defendants to generate electric light, and also for agricultural and farm uses. Defendants counterclaimed £90 balance due on the purchase price.

Mr. Abel Thomas, K.C., with Mr. F. O. Robinson, was counsel for the plaintiff; and Mr. Norman Craig, K.C., with Mr. Schiller, appeared for the defence.

Mr. Thomas stated that his client was a retired Indian official living on his estate in Scotland. In July of 1907, he was desirous of cultivating his estate by engine power instead of by horses, and also of lighting his house with electricity. He communicated with the defendants with a view to procuring a motor which would do these things, with the result that he eventually agreed to purchase a 30-H.P. Universal tractor for the sum of £370, which the defendants declared would do what plaintiff required of it, and which had the advantage of being able to run on petroleum as well as petrol. At plaintiff's request defendant firm sent a representative to Perthshire, and a contract was entered into for the lighting of Mr. Anderson's premises with electricity at a cost of £400. After considerable delay, continued counsel, the tractor was delivered; when plaintiff came to work it, he found that it would not burn petroleum as stated by defendants, and furthermore, it was most extravagant in its consumption of petrol. It failed to do the work required, and caused considerable trouble. Eventually, plaintiff had it examined by an expert engineer, and as a result asked defendants to take the engine back. This they had refused to do. Plaintiff declared that the motor was inefficient for the work, that the construction of the carburetter was faulty, causing excessive use of petrol; further, that the ignition was faulty, and that the system of accumulators, coils, contact breakers and wiring was so intricate that only a skilled mechanic could work it. Further, the contact-breakers were insufficiently protected against dust and rain water; the cylinders, too, were faulty in construction, and the water jackets leaked. With regard to all these points defendants had been guilty of a breach of their contract and warranties, and his client claimed the return of the moneys paid, or damages. The defendants, concluded counsel, denied that there was any breach of contract or that the engine was inefficient, and they counterclaimed £90, the balance of the purchase price of the motor.

Mr. Black, plaintiff's agent, was called, and supported counsel's statement. In cross-examination, Witness admitted that to use a 30-H.P. motor to run the electric light installation would, in itself, be a very wasteful process, but the machine was also required to drive a threshing mill, which would consume about 20 H.P., and the dynamo was to be driven at the same time.

Evidence was given by Mr. Douglas, consulting engineer, of Dundee, Mr. William R. Bell, a mechanical engineer engaged in the motor trade, and others.

The hearing was resumed on Saturday and Monday.

After further evidence for the plaintiff had been called, Mr. Norman Craig, for the defence, declared that the truth of the case was that the plaintiff, having purchased the tractor, found it was too expensive for his requirements, and wanted to throw it back on defendants. The bulk of its work consisted of driving the dynamo for the electric light, and for that purpose the machine was much too powerful. It was suggested at the time that it would be more economical to purchase a smaller engine to drive the electric lighting plant, and use the tractor simply for farm work, but plaintiff would not agree. No warranty had ever been given with the machine, and it was quite capable of doing all that was required of it.

Mr. H. P. Saunderson, managing director of the defendant company, said his firm had sold motors, such as that supplied to the plaintiff, in all parts of the world. The machines had successfully stood the tests at all sorts of agricultural shows, and had won medals at home and abroad. These motors would run on paraffin, and worked well.

Other evidence was also called by defendants to uphold the reputation of the machine, and Prof. Capper, of London University, stated that the motor was sufficient for all the purposes for which it was designed.

The jury returned a verdict for the plaintiff, awarding damages £290. The machine, they held, did not come up to guarantee, and plaintiff was entitled to return it.

Judgment was entered accordingly, with costs, and stay of execution was refused.

Workmen's Compensation Claim.

In the Manchester County Court on Wednesday last week a claim for an award of 15s. 4d. per week was made by an electrician's wireman named John Daley, of Rochdale Road. While assisting in an electrical installation in Piccadilly for Messrs. Bentley & Co., of Newton Street, he fell from a ladder on a concrete floor, dislocating his elbow and receiving other injuries.

Mr. Mainprice said compensation was paid until July 26th. Daley was operated upon for a rupture which he alleged was caused by the accident, and after the payment stopped the matter was referred to a medical referee, who had decided that the rupture was not caused by the accident, and that the applicant was now quite fit to do his work. He had tried to find work, but had been unsuccessful, and Mr. Mainprice therefore submitted that as the inability to get work was due to the accident happening, he was entitled to an award until he was able to get something to do.

Judge Parry said that the contention was an ingenious attempt to get outside the Act of Parliament, but it was questionable whether it would be worth while to take it to the House of Lords. This was not like the case of a man with a broken limb or a lost limb. Employers refused to take them on again because of the loss. The medical referee having found that the incapacity caused by the accident was at an end, there must be an award for the respondents, but the costs would not be taxed unless further proceedings were taken.

Electrical Apparatus in Fife Mines.

A prosecution of interest to all concerned with the management of mines where electrical apparatus is in use was heard on Thursday last week before the Sheriff at Dunfermline. Charles Augustus Carlow and Henry Rowan, described as "managers and agents" appointed by the Fife Coal Co., were charged with having, between April 1st and August 7th, permitted the use at the company's Foulford Pit, Cowdenbeath, of electrical plant and apparatus which did not conform with the special electrical rules, and that despite the fact that on April 30th Mr. Robert McLaren, H.M. Inspector of Mines, had addressed a letter to the company directing

that the plant and apparatus should be made to conform with the rules. William Edward Richardson, certified colliery manager at Foulford Pit, was also similarly charged. In each case the charge was denied. Mr. J. S. Soutar conducted the prosecution, and among those present were Mr. McLaren, and Mr. Robert Nelson, a Home Office expert. The respondents were represented by Mr. R. S. Horne, advocate, who was accompanied by various mining and electrical experts.

Mr. C. A. Carlow was called first as a witness against Richardson. He said the company had 37 pits, and four were being sunk. Part of his duty was to look after the stores, upon which was expended yearly anything up to £240,000. All the officials of the company had before them a complete statement of what was required of them by law. At every colliery where there was an electrical installation, there was a man more or less skilled in electricity, and nine months ago the company had appointed a Mr. Fraser, an electrical engineer, who was specially trained in colliery work, to have charge of all electrical plant. A year and a half ago they had commenced a process of making all the machinery conform to the rules independently of any instructions from the Mines Inspectors, and during that time they had scrapped machinery to the value of thousands and thousands of pounds. When any agent complained that certain plant was not in good order, the company had never refused to accede to his wishes. Their attitude was absolute willingness to carry out all suggestions made by the Mines Inspectors for the safety of the men. They wanted to have it proved, after spending thousands of pounds, that cables were unsafe before sending them to the scrap heap. Answering the Sheriff, Mr. Carlow said he practically ignored the letter of January 30th sent by Mr. McLaren, and he did not think it his duty to send the letter to the party whom he considered responsible.

Mr. Henry Rowan asserted that Mr. C. A. Carlow had nothing whatever to do with seeing the rules enforced in the pits. Two years before Mr. McLaren had directed the company to make the machinery conform with the special rules, witness had given instructions to that effect, and when Mr. McLaren wrote, the improvements were still proceeding. From October, 1908, to January, 1909, between £300 and £400 had been spent on the plant at Foulford Pit, and what was complained of involved very little expense. The complaint was attended to immediately on his attention being drawn to it in August. If there was a difference of opinion in regard to electrical matters between H.M. Inspector and himself, he would defer to the Inspector.

Mr. Charles Carlow, managing director of the company, said he did not see Mr. McLaren's letter of January 30th, but he would have treated it in the same way as his son did. It was a circular on the face of it, and was of no importance to the company, who had already determined that their plant was to be brought up to the regulations. Answering Mr. Horne, witness said Mr. Rowan was one of the most expert colliery managers in Scotland, and was highly paid for his responsibility and experience. If responsibility were to be fastened on to the head office—on to his son and himself—that would mean that the men who were paid for handling the works, the managers, had no responsibility under the Act. Such a practice would tend to the very opposite of efficiency.

Mr. Robert McLaren, H.M. Inspector of Mines, said that his letter was the result of a trial in the Sheriff Court which failed because intimation had not been sent by him to the owners to comply with the regulations. He had sent the intimation to 37 owners in Scotland. What was meant by the letter was that where electric plant had been put in prior to the establishment of the special rules in April, 1905, that plant should be taken out at once, and made to comply with the rules. If Mr. Carlow, jun., had taken the trouble to look at the back of his notice, he would have discovered that a number of pits, including Foulford, were specified.

Mr. Horne objected to this evidence, because in the letter in process, there were no pits named, and the Sheriff upheld the objection.

Cross examined, the Inspector said he had not gone down Foulford Pit, but his assistants had made him aware of the plant being defective. He thought the best way to bring the owners up to the scratch was to take the bull by the horns. The source of danger lay in the cables carrying 500 volts being bare at points. He could not tell what subjects in Foulford Pit were complained of prior to January 30th, 1909.

Mr. Horne: As a Government inspector, are you here to say that your assistants informed you of defects in electrical plant in Foulford Pit prior to January 30th, and you have no note of these?

Witness: I do not have them here, but I have them at home. I expected as an honest man——

Mr. Horne: I am not disputing your honesty. They were not going down to that level. But it was a most extraordinary state of matters that he was bringing out a complaint without knowing his facts. To the witness: Give me the date when you first got information from an assistant with regard to any of the matters now complained of.

Witness: April 30th, from Mr. Masterton. He complained that a gate-end box was not earthed, and that electric cables were not properly hung on the roadside. Subsequently, he got information about the fuses, switchbox and abrasions in the cables from Messrs. Nelson and Masterton, who made a joint inspection of Foulford Pit.

At this point, Mr. Horne contended that the case had broken down in respect that more than three months had been allowed to elapse between the time the matters complained of arose and the institution of proceedings. After considering the point, the Sheriff said the Act admitted of more than one interpretation, and at that stage the proper course for him was to repel the objection and let it come before the High Court.

Mr. John Masterton, assistant inspector of mines, stated that there was evidence of carelessness at various points in fixing the cables. He found the wires of a cable exposed to the extent of $\frac{1}{16}$ in., which was sufficient to kill a man. At one point he saw a cable resting on a rail, which was a contravention. Witness also spoke to seeing portions of the cable where the insulation was damaged and the wire exposed and a place where the tubes were rubbing on the cable.

Mr. Robert Nelson, electrical expert at the Home Office, said he found the cable very much abraded, and he very quickly found bare parts, in spite of the fact that he could not give undivided attention to the cable. Witness also spoke to finding defective earthing at the terminal boxes, and he objected to the type of switches and fuses in use for lighting. He did not consider it unreasonable or impracticable to work up to the rules. He thought the rules represented the minimum of safety.

Among others who gave expert evidence were Mr. William Charles Hawtayne, consulting electrical engineer, London; Mr. Ernest Adie Runciman, electrician for the company in the Cowdenbeath district; Charles George, overman at Foulford Pit; and James Maguire, pit fireman.

The first witness for the defence was Mr. Henry Savage, of Henley's Telegraph Works, London and Glasgow, who stated that his firm supplied the cable, the construction of which he described. He added that there was no danger from the mere outside surface of the cable being frayed, so long as the insulation next the wires was intact.

The Court rose after sitting nearly eight hours, and it was agreed to hear the rest of the evidence on December 6th.

The Electro-Peat Coal Co. Litigation.—Mr. Darlington Simpson's Appeal Allowed.

On the resumed hearing of the appeal by Mr. George Darlington Simpson from the judgment of Mr. Justice Lawrence on the finding of a special jury in the case of Barker *v.* Earl Mayo, holding him liable for certain alleged misstatements in a prospectus of the Electro-Peat Coal Co., Ltd. Mr. Cozens-Hardy argued that there was no evidence whatever to justify the finding of the fact, that Mr. Simpson had authorised the particular document complained of being shown to the underwriters. He contended that the only material fact was, did Mr. Simpson mislead the plaintiff by showing him, or by authorising the showing to him, the prospectus in question? He submitted with deference that there was confusion in the mind of the learned judge in the Court below, and he had not distinguished between "showing" and "authorising the showing." The promoters of the company were undoubtedly the Electro-Peat Coal Syndicate. Bowden and Walker were either members of that syndicate or were employed by it, but it was never proved or ever suggested that Mr. Simpson ever had a share in it. As a matter of fact he had not; and a very significant fact was that neither Bowden nor Walker was called at the trial to say that he had shown the prospectus to the plaintiff or brought it to his knowledge by anyone's authority. It was not done on the authority of Mr. Simpson, and one would have thought that if the plaintiff wanted to prove authority he would have called both Bowden and Walker.

Lord Justice Fletcher Moulton pointed out that as the appellant had no opponent they must look at the evidence. If there was no evidence he must succeed.

Mr. Cozens-Hardy said the way it was put was that there were meetings of the intending directors, and it was decided that the company must have underwriters. At a meeting of January 18th—two days before the prospectus was shown by Bowden to the plaintiff—a document was produced. Mr. Simpson was present at a meeting and saw it, and, according to his evidence, it was the only document he saw. The document had blanks for the names of directors, and on the back was a note intimating that the prospectus was subject to such improvements or modifications as might be approved by counsel. Mr. Simpson was not a director, and did not sign that document, and the prospectus of January 20th he never saw. The only one he saw was that of January 18th, and that was shown to Mr. Barker by some one else.

Lord Justice Fletcher Moulton suggested that all it was necessary for Mr. Simpson to prove was that there was no evidence of any authority to show the prospectus.

Mr. Cozens-Hardy: The one agreed fact in the case, as Sir Edward Carson, who represented the Earl of Mayo, said, was that the Peat Coal Syndicate was the promoter. He (counsel) was not concerned with the April prospectus, as with regard to that the jury had found in Mr. Simpson's favour.

After considering the evidence, the Master of the Rolls, in giving judgment, said that it seemed to him that there was absolutely no evidence to support the finding of the jury that Mr. Simpson, or, in fact, any of the defendants, authorised the showing of the prospectus to the plaintiff. He thought, therefore, that there had been a miscarriage of justice. The learned judge in the Court below in his summing-up seemed to have really treated the question as a formal and unnecessary one which could only be answered in one way. He much regretted that the Court had not had the benefit of hearing an opponent to the appeal, because with a case that had lasted 17 days in the Court below, it was not satisfactory to ask the Court to say that there was no evidence to support the findings of the jury. Having regard, however, to the fact that the plaintiff did not think fit to appear, it seemed to him they were bound to allow the appeal, and judgment must be entered for Mr. Simpson.

Lord Justice Moulton: I entirely agree.

Lord Justice Farwell also agreed, and the appeal was accordingly allowed.

The Proceedings Against the Welsbach Co.

At the Clerkenwell Police Court on Saturday, Mr. Bros resumed the hearing of the summons issued against the Welsbach Incandescent Gas Light Co., Ltd., at the instance of the Wolfram (Tungsten) Metal-Filament Lamps, Ltd., and the General Electric Co., Ltd. This was the fifth day of the hearing.

Mr. Rufus Isaacs, K.C., M.P., Mr. H. A. Colefax and Mr. Ernest Lunge appeared in support of the summons, and Mr. A. J. Walter, K.C., and Mr. Bodkin represented the defendant company.

Dr. Otto Oberlaudeb, a doctor of philosophy, and consulting chemist and engineer, 29, Queen Street, E.C., was the first witness. He said that for a number of years he had followed the development of electric lighting, and had been professionally associated with it. He was acquainted with the publications that referred to new inventions in electric lighting, and was familiar with the manufacture of metal-filament lamps. He had previously seen the two lamps produced. One was sent to him in Berlin. It was handed to him by Mr. Remane, of the German Auer Co., and the other was given to him by Mr. Fletcher, of the General Electric Co. Each one was marked "Welsbach" "Aur." He was acquainted with Baron von Welsbach, and osmium was used by Welsbach for the metal-filament lamp. His examination of the lamp produced enabled him to say that it was made of tungsten or wolfram. The osmium lamp was invented by Dr. Welsbach, and patented in 1898. When the invention was published it commanded the attention of technical people throughout Germany. Previous to that time the filament of an electric lamp was made of carbon, and the osmium lamp showed a distinct advantage over the carbon lamp, giving about twice as much light with the same power. The osmium lamps were introduced into this country on a commercial scale about 1903 or 1904. Dr. Welsbach had applied for other patents apart from this lamp. In so far as these lamps related to filament lamps they all referred to osmium lamps, and the Welsbach electric lamp was one whose filament was made of osmium. They were put on the market by the German company. He had seen the company called by several names in technical and English publications. In this country it was called "Auer Gesellschaft," "Auer Company" and "Auer Society," and was so known in this country. After the publication here of Welsbach's invention, the question of the filament of electric lamps was further investigated, and in 1904 a filament of wolfram or tungsten, a metal known by both names, was proposed. The German Auer Co. made lamps in accordance with that invention. They commenced in 1905, and the sale of the lamps had, to his knowledge, been a very large one. They were introduced into this country by the General Electric Co. Witness had frequently seen such lamps in this country with marks on them indicating that they came from the Auer Co. That company had, from his knowledge of the trade, been the reputed manufacturers of the Osram lamp. Some of these lamps had been made in this country since last year.

Mr. Rufus Isaacs: Would it be right to describe a lamp whose filament is made of osmium as the invention of Baron von Welsbach?—Yes.

Would it be right to describe a lamp whose filament is made of tungsten as an invention of Baron von Welsbach?—No. Osmium and tungsten are totally different metals.

The name of Welsbach was well known in the lighting world. It was one of the best known names. It had become known in connection with incandescent gas lighting.

Have you ever heard of the defendants making metal-filament lamps?—No.

Replying to a further question, Witness said the lamp produced (Exhibit 7) was not made by the Welsbach Co. It was made by Ehrich & Graetz.

Cross-examined by Mr. Walter, the Witness said he knew that tungsten or wolfram was patented in 1889 for metallic-filament lamps, but that did not lead to the tungsten lamp. He had not heard of proceedings being taken against the Welsbach Co. by Just and Hanaman.

Mr. Walter: Are these proceedings in the police court taken because the owners of the patent are unable to sue the Welsbach Co. for infringement?—No, they are not.

Were you aware that the name "Auer Gesellschaft" was dropped because of the complaint of the defendant company?—It was dropped at the request of the General Electric Co., and the letters "G.E.C." were substituted. The osmium lamps were not a commercial success, but the Osram lamps had been a very great commercial success.

Do you know of any lamp prior to the lamp now complained of, that had ever been put upon the market with the word "Welsbach" upon it?—No, I don't.

Or of any electric lamp being put upon the market with the letters "Aur" upon it?—I do not.

Are you prepared to deny that the word "Welsbach" on merchandise in this country commonly means goods of the Welsbach Co?—It does not include electrical goods.

Are you prepared to deny that the letters "Aur" upon merchandise commonly means merchandise of the Welsbach Co.?—I deny it in connection with electrical goods.

Do you suggest that Welsbach's inventions with regard to metal-filament lamps were confined to osmium?—I do.

Have the defendants to your knowledge ever described the wolfram tungsten lamp as the Welsbach lamp?—I have seen it so described in many publications, but it was wrongly described.

Mr. Duncan Watson, of 102, Charing Cross Road, a member of the Institution of Electrical Engineers, said he had had a great deal of experience in electrical matters, including electric lighting. He remembered the introduction of osmium lamps. He first heard of it through information contained in a technical paper. The lamp was a great improvement on all other metal-filament lamps. An advertisement which appeared in the *Daily Telegraph* of September 22nd conveyed to him the impression that the lamp referred to must be the osmium lamp under the Welsbach name. He formed that opinion because it had on it the words "Welsbach" and "Aur," and further stated that the metallic-filament lamp was invented by Baron von Welsbach.

Mr. Walter (cross-examining): You have known for years of the Welsbach Co., and that the word "Welsbach" upon goods in the United Kingdom means goods of the Welsbach Co.?—Certainly.

And you have know for years that the trade mark of the Welsbach Co. has been "AUR"?—No. I did not know that until I heard it in this Court a fortnight ago. Witness added that he had taken no interest in the Welsbach Co. from the point of view of their trade mark, but he had been interested in the company in other respects. It was what he saw in the technical journals principally that made him think the lamp referred to was the osmium lamp.

Do you mean that looking at the picture you thought from the shape of the lamp that it was the osmium lamp?—My answer is that the similarity of the lamp and the words "Welsbach" and "Aur" made me think so.

You have never seen a lamp labelled "Welsbach" except the lamp put upon the market by the defendant company?—No.

If you had known that the trade mark "Aur" was the trade mark of the Welsbach Co., you would have arrived at a different conclusion?—No, I should have thought it was very smart on their part. I should have thought it was very good as far as they are concerned, inasmuch as it is connected with the name of Baron von Welsbach.

Will you refer me to a single advertisement of the General Electric Co., or any company handling the Osram lamps, that refers to the "Auer" or to "Welsbach?"

The Witness said he would have pleasure in handing several publications to counsel, in which these references appeared. He produced the Electrical Review of October 5th, 1906.

This is a paper circulating amongst electrical engineers?—Yes.

And this is an article describing modern glow lamps?—Yes.

Counsel quoted from the article, which was to the effect that one of the latest of these lamps is the Osram, in which the filament consisted of a layer of osmium with wolfram. There was also a reference to the German Welsbach Co. introducing this lamp. Witness also produced the Electrical Review of January 24th, 1908.

Mr. Walter: I see—the same paper, circulating amongst the same class?—Yes.

Counsel then quoted from page 156, announcing that a French company would shortly be formed to utilise the Austrian patents for the wolfram lamp, that the Industrial Wolfram Co., and the German Incandescent Gas Lamp Co., of Berlin, would participate in the undertaking, which was to have a share capital of £188,000. Witness further produced a copy of the Electrical Review of October 30th, 1908, which referred to "a German view" of the future of the metallic-filament lamp. He also produced a paper by Mr. Hirst, of the General Electric Co., read before the Institution of Electrical Engineers on May 21st, 1908, and also a copy of the *Review of Reviews*, containing an interview with himself (the witness), entitled "Electricity *v.* Gas."

Are you the Mr. Duncan Watson mentioned in this interview?—There is not another one that I know of.

Is this in the advertising part of the paper, or is it an inset?—Not at all; it is news of the most interesting kind. I may say it would be utterly impossible to have that published as an advertisement.

Extracts from these publications were read.

In further cross-examination, the Witness said that he knew the Osram lamp had nothing to do with Welsbach.

Tell me, the General Electric Co. do not happen to be interested in your business, are they?—That is about the last question I should have expected to be asked here. Certainly not, or any other concern of any kind at all.

Mr. Walter: It was merely a matter of curiosity. What made you think this was an Osram lamp?—For the very simple reason that lamps of precisely the same manufacture are sold under various names. I mean that lamps coming from the same factory are sold by retailers with a name purporting to give it distinction. Carbon-filament lamps, although coming from the same factory, have been known to be sold under different names.

Replying to further questions, Witness said he thought that Baron von Welsbach had something to do with the Osram lamp, because the "Auer Gesellschaft" and Baron von Welsbach, he understood, were very closely connected. He always thought the connection was a very direct one, inasmuch as the product of the same factory was the Osram.

Re-examined by Mr. Isaacs: According to the Electrical Review of June 19th, 1906, it was announced that the German "Auer" Co. was introducing the Osram lamp?—Precisely.

If that is stated in a paper like that, would it become generally known?—There is no question about that.

And was it, in fact, generally known from the time of the introduction that the "Auer" Co. were manufacturing and introducing it into this country?—Yes.

In the trade?—Exactly.

I see the Electrical Review that was referred to is a technical paper. Is that a paper which is seen and which circulates among

the trade?—Yes, it is the oldest and, I believe, retains the largest circulation.

The suggestion is that it only circulates among scientists?—I have no doubt that many members of my profession would deem it an honour to be called a scientist.

I notice in looking at the ELECTRICAL REVIEW that a very large portion of it consists of trade advertisements?—Exactly.

The hearing was adjourned until Saturday, December 4th.

ALUMINIUM CORPORATION, LTD.

IN the Companies' Court on Tuesday, Mr. Justice Swinfen Eady had before him a petition by the Aluminium Corporation and its liquidator for the sanction of the Court to a scheme for the transfer of its assets to a new company.

MR. YOUNGER, K.C; in support of the petition, stated that the company, which had works at Newcastle-on-Tyne, Dolgarrog, North Wales, and elsewhere, was incorporated with a capital of £500,000. Of that amount £440,000 was in 7 per cent. participating preference shares and £60,000 was in ordinary shares. The preference shares had a participating cumulative preference of 7 per cent., the ordinary a non-cumulative preference of 7 per cent., and of the remainder of the profits 40 per cent. was to be divided amongst the preference, and 60 per cent. amongst the ordinary shareholders. Of the preference, 257,205 £1 shares were issued, and of these 252,220 were fully paid, 2,826 had 15s. per share paid upon them, and 2,159 had 10s. per share paid. There was a debenture issue of £26,906 odd, and a large unsecured debt. In 1908 the company was wound up, and liquidators were appointed in March of that year. In May a scheme of arrangement was sanctioned by Mr. Justice Neville, but it fell through owing to the company being unable to find sufficient cash to carry it out, and an attempt by the liquidators to realise the company's property had also proved abortive. By the scheme now proposed the general creditors would be paid in full in cash, those unsecured creditors whose debts were under £10 would be paid in full in cash, those unsecured with debts of over £10 would receive preference shares in the new company to the nominal value of their debt, and the shareholders would receive partly-paid shares in the new company.

His LORDSHIP asked if the affairs of this company had not been before him on a previous occasion.

MR. YOUNGER said that this company must not be confused with the British Aluminium Co., which was a much larger concern.

There was no opposition, and subject to some slight alteration and the production of evidence as to the willingness of the shareholders to take the new shares, his Lordship sanctioned the scheme as proposed.

LONDON ELECTRIC SUPPLY COMPANIES AND COMPULSORY PURCHASE.

AN advertisement appeared in the *Times* of November 19th, which shows that it is the intention of the London County Council to apply for an Act of Parliament for the purpose of becoming the purchasing authority of the undertakings in the County of London. This proposal is obviously part of a general scheme by which the entire production of electricity in London may become vested in the County Council. The exact objects of the proposed Act are thus defined.

To constitute or make provision for constituting the London County Council (hereinafter called "the Council") the purchasing authority of the undertakings (in which expression is included lands, buildings, works, materials, plant, property, rights, powers and privileges) of the companies in lieu of, and in substitution for, the local authorities as defined by the Electric Lighting Acts, 1882 and 1888, or any other local authority or authorities by whom any such undertaking or any part thereof, may be purchaseable, either under those Acts or under the London (Westminster and Kensington) Electric Supply Companies' Act, 1908, or under any of the Acts and orders regulating the several companies mentioned in the second column of the said table, and for that purpose to extend and make applicable to, or to re-enact with respect to the said companies, or any of them, all or any of the provisions of Secs. 23 to 27, both inclusive, of the London Electric Supply Act, 1908, either without modification, or with such modification as may be contained in the said intended Act.

The names of the companies set out in the table are the Kensington and Knightsbridge Co., the Notting Hill Electric Lighting Co., the St. James' and Pall Mall Co., the Central and Electric Supply Co. and the Westminster Electric Supply Corporation.

To properly understand this notice, it is necessary to refer to the London Electric Supply Act, 1908, Ch. CLXVII, which provides by Sec. 23 (1) that the County Council may purchase any undertaking which may be purchased by a local authority. The County Council must, however, give three years' notice of their intention to exercise such powers. By Sub-sec. (2) the County Council cannot give notice to purchase the undertaking of any one company unless they shall at the same time give notice to purchase the undertaking of all the companies. By Sub-sec. (3) the terms of purchase are to be as set forth in the Electric Lighting Act, 1888, Sec. 2, subject to this, that the undertaking of the Charing Cross Co. is to be purchased on special terms, and that of the City of London Electric Lighting Co., Ltd., is to be entitled to compensation for profits which might have been made by that company between August 2nd, 1900, and August 18th, 1932. By Sub-sec. (5) the date of purchase is to be August 26th, 1931. By Sec. 24 certain restrictions are placed upon the companies increasing their charges after the notice to purchase has been given by the County Council; by Sec. 25 the County Council may discharge any part not exceeding three-fourths of the sum payable to a supply company in respect of such purchase; by Sec. 26 the Council may make certain advances to the companies, and by Sec. 27 provision is made for expenditure by the London County Council.

The local authorities which are now empowered to purchase by the Electric Lighting Act of 1888, are enumerated in the schedule to the Electric Lighting Act, 1882. Broadly speaking, they are the London Borough Councils. It remains to be seen what attitude these bodies, or such of them as have electric lighting companies within their boundaries, are likely to take up towards the proposed Bill of the London County Council. Having regard to the fact that this is an attempt to unify the supply of electricity all over London, it may well be that some of the Borough Councils would be glad to retain the right which Parliament has given them, while others would be glad to part with it if they were to be adequately compensated.

It is interesting at this point to consider what is meant by compulsory purchase.

The law on the subject is to be found in Sec. 2 of the Electric Lighting Act, 1888. It is therein provided that a local authority within whose area the property of a supply company is situate, may within six months after the expiration of 42 years from the date of the passing of the company's provisional order, and within six months after the expiration of every subsequent period of 10 years, require the company to sell the undertaking. The terms upon which such request may be made are that the local authority will pay: "the then value of all lands, buildings, works, materials, and plant of such undertakers suitable to and used by them for the purposes of their undertaking within such jurisdiction, such value to be in case of difference determined by arbitration." Pausing here, it will be seen that the local authority is under no compulsion to buy the undertaking; it merely has an option to do so, and, when we consider the terms upon which the purchase must be effected, it is quite possible that when the time arrives, the local authorities will not care to speculate. The terms are as follows:—"The value of such land, buildings, works, buildings and plant shall be deemed to be their fair market value at the time of purchase, due regard being had to the nature of and then condition of such buildings, works, material and plant and to the state of repair thereof, and to the circumstance that they are in such a condition as to be ready for immediate working, and to the suitability of the same to the purposes of the undertaking, and, where a part only of the undertaking is purchased, to any loss occasioned by severance; but without any addition in respect of compulsory purchase, or of goodwill, or of any profits which may or might have been or be made from the undertaking, or of any similar considerations."

The reference to compensation for compulsory purchase excludes anything like the 10 per cent. which is added to the purchase price of land required under the Lands Clauses Acts. It may therefore be assumed that all the companies selling their undertakings would get would be the actual value. There would be nothing to be made out of it. But would the local authority be a likely purchaser?

In County of London orders in favour of companies it has been the practice to provide that the period of 42 years shall run from one fixed date—that is to say, August 26th, 1889. The object in view evidently was to secure that in the event of a purchase all the electric lighting concerns of

the metropolis in the hands of undertakers other than local authorities, might be acquired at one and the same time. It is obvious it must have been contemplated that the County Council or some similar body would decide to purchase; but it is not very easy to see what there will be to compel the local authorities who now supply electricity to sell their undertakings to the County Council. We know of no statute by which they can be compelled to do so, and it was obviously contemplated, when the Act of 1888 was passed, that the local authorities in London would be ready and anxious to become undertakers themselves.

It is probable, however, that when the time for exercising this right to purchase compulsorily does arrive, the fact that the right is to be exercised by the County Council will be of enormous advantage to the companies and their shareholders. It is difficult to foresee what may be the state of affairs in 1931—the earliest date when such a purchase can be effected. And in presence of such uncertainty it is hardly to be supposed that any prudent board of directors is relying much upon what the property of the company will fetch in 1931, especially having regard to the old iron prices prescribed by statute.

One other point remains to be considered: it is a matter which will doubtless be provided for in the Bill for which the London County Council are going to Parliament. Sec. 3 of the Electric Lighting Act, 1888, authorises the Board of Trade to vary the terms upon which a local authority may require the undertakers to sell *in such manner as may have been agreed upon between such local authority and the undertakers*. Assuming that the County Council steps into the shoes of the borough councils, this section would enable the County Council to negotiate privately for the purchase of all the property of the London Electric Supply companies.

Whether this is one of the objects which the County Council have in view must only be the subject of conjecture.

BUSINESS NOTES.

Universal Domestic Motor.—With reference to the letter on this subject in our last issue, Mr. E. E. Coy, of 77, St. John's Road, Bootle, Liverpool, sends us the specification of his special small-power motor, which, he contends, meets the case. It develops ¼ horse at about 2,600 R.P.M., and can be attached by means of an adapter to any ordinary lampholder; the price is quite moderate. It can be supplied at a small extra cost mounted on a suitable wooden base with S.P. switch and D.P. fuses, and no starter is required. The motors are a speciality, and are of standard pattern, being the same as used in his "Whipall" electric tire pump recently described in our pages. They are supplied for any voltage up to 250 at the same price, and have been used for organ blowing.

Mr. F. T. Turquand also writes to say that he has recently seen an electric motor fitted up as Mr. Urquhart suggests. It is apparently a new invention, and is said to be entirely fool-proof. It is lighter than other motors for the same power, can be reversed under full load, and started also without external resistance or starting switch. The armature can be jammed up at full voltage without injury to the motor. A spindle is carried on to which several domestic appliances can be fitted, *e.g.*, tooth wheels, polishing buffs, blacking brushes, &c. The company marketing this novel and useful application of electricity is, he says, the Dynamic Co., Ltd., 6, Broad Street Place, E.C.

Turkey (Asia Minor).—The *Bulletin Commercial* (*Brussels*) of November 6th states, on the authority of the Belgian Consul-General at Smyrna, that there are good openings in that town for electrical machines and accessories. Attention is drawn particularly to continuous-current dynamos of 2 to 15 KW., switchboards, arc lamps, incandescent lamps with metal filament, electric bells, private telephone installations, &c. For the purpose of securing a market, firms should above all choose a reliable agent, possessing a good general knowledge, and he should be allowed a large measure of discretion and initiative. Articles sent to Smyrna must be of the best pattern, and possess all the most modern improvements.—*Board of Trade Journal.*

Manchester Engineering Exhibition, 1910.—We have received a prospectus relating to the exhibition scheme which is being promoted by our contemporary, the *Engineering Review*. The show will take place in the City Exhibition Hall, Manchester, in October next.

"Luxrae" Lamps.—The Globe Electric Co., Ltd., of Farringdon Avenue, announce a reduction in the price of their "Luxrae" flame lamp, bringing the flame lamp more easily within the reach of the small shopkeeper.

Exhibition.—A Naval, Mercantile Marine and Engineering Exhibition is to be held at Olympia in September next year. It is being promoted by Mr. F. W. Bridges.

Installation Contract.—The Standard Engineering Co., Ltd., have secured the order in connection with the heating and ventilation of the new motor cab garage now being built by Messrs. Panhard & Levassor at Acton Vale, London, W. Messrs. Panhard & Levassor decided to adopt the firm's "Stanlock Multiple Unit System" after investigating existing installations and giving the system a trial in their works. The building in question is approximately 600 ft. long by 300 ft. wide.

Meter Approved.—The B. of T. has approved of the Siemens-Schuckert meter for continuous current, type G.B., deposited last May by the firm of Siemens Bros. Dynamo Works, Ltd.

For Sale.—On Tuesday, December 7th, by order of the Receiver of Kupron, Ltd., Mr. E. H. Henry will offer for sale by auction at Clapham, the plant, machinery and stock of the company. The Marylebone Electricity Supply Department is offering a large secondary battery and certain plant, scrap metal, &c., for sale. The Receiver of the New Ignition Syndicate is offering the undertaking of that company for disposal. See our advertisement pages.

A number of steam dynamos (500, 250 and 60 KW.) and a 120-KW. alternator, boilers, &c., are offered for sale by the Cape Government Railways. Some particulars are given in an advertisement to-day.

Concert.—The Devonport Dockyard Electrical Fitters' Association, which has entered upon its third year, held its first smoking concert of the season at Ackland's Clarence Hotel, Morice Town, on Saturday evening.

Spain.—Although there is a large exportation of English coal to Spain that country possesses extensive coal deposits, the working of which, however, is impossible owing to lack of railway facilities. Attention is now being directed to this subject and *Industria e Invenciones* affirms its belief that a well-studied network of coal railways worked by hydro-electric power, which may be obtained from the various waterfalls in the Pyrenees now unexploited, can supply to Barcelona, and the manufacturers of Catalonia, cheap coal able to compete alike with that from the Asturias and from England.

New Works.—The Madison Dynamo Co. have just started new works at Littleover, near Derby, a suburb which is now being rapidly developed.

Canada.—The Canadian Customs authorities have recently given a decision to the effect that "submarine cable" is dutiable at the rate of 30 per cent. *ad valorem* in the case of foreign goods and 20 per cent. in the case of British manufacture, under No. 407 of the Tariff.

Book Notices.—*Electricity in the Service of Man.* By Dr. R. Mullineux Walmsley. London: Cassell & Co., Ltd.—The publishers are issuing this work in monthly parts, price 6d. each, of which the first part has come to hand. It will be remembered that Dr. Walmsley some years ago practically re-wrote the book, and the first volume has been reviewed in our pages; the second, so far as we know, has not yet been issued. The complete work, we presume, will now appear in parts, and, judging by what we have already seen of it, will constitute a very comprehensive survey of the history, development, and present state of electrical science as applied to modern life.

City and Guilds of London Institute: Report of the work of the department of Technology, 1908-9. London: John Murray.—The Report shows that the number of students in the electrical industries is rising steadily, with the exception of a slight fall of the number of candidates in the elementary examination in electrical engineering—due to an abnormal rise last year, when this examination became a compulsory preliminary to the Ordinary Grade. The examiners comment on the inability of candidates in Telegraphy and Telephony to answer questions involving simple mathematics; and in Electrical Engineering the results are said to be discouraging, the occurrence of the same defects in batches of consecutive papers indicating that the teaching is too often at fault. As the examiners rightly point out, unless the teacher is a practical engineer, in touch with modern practice, satisfactory results cannot be expected. Candidates in Honours Electrical Engineering are warned that they must expect to find questions involving mathematical knowledge increasingly numerous and searching. An interesting diagram is given, showing the growth of the department's work since 1880.

"Practical Testing of Electrical Machines." By L. Oulton and N. J. Wilson. London: Whittaker and Co. 1909. Price 4s. 6d. net.

"Journal of the Western Society of Engineers," Vol. XIV, No. 5, October, 1909. Chicago: The Society.

"Electrotechnics." By J. Henderson. Vol. III. Longmans, Green & Co. 1909. Price 3s. 6d.

"The Physical Review," Vol. XXIX, No. 5. November, 1909. New York: The Macmillan Co.

"Journal of the American Society of Mechanical Engineers." Vol. XXXI, No. 11. November, 1909. Baltimore, Md.: From the Society.

"Auto-Transformer Design." By W. H. Avery. London: E. and F. N. Spon, Ltd. 1909. Price 3s 6d. net.

From the P. and O. Steam Navigation Co. we have received a fine hanging wall-sheet executed in colour; its outstanding feature is a view of Gibraltar, with one of the company's well-known passenger vessels under weigh. Beneath this are given in tabular form particulars of the dates of outward and homeward mails during 1910. A list of the P. and O. ships and their registered tonnages is given. This sheet should be of considerable service in the commercial departments of firms doing business with Egypt, India, Siam, China and Japan, Australia, and other Eastern parts.

The receipt of *Pears' Annual* reminds us that the Christmas season is not many weeks away. A perusal of the 1909 issue of this indispensable feature of Yuletide, and its four accompanying coloured plates, leads us to say that it is well worth the modest sixpence that is charged for it. The advertisement pages are as full of interest as are the editorial.

Trade Announcements.—Mr. S. N. Brayshaw, of Manchester, reports that his trade in milling cutters and other small tools is growing very satisfactorily, and his patent hardening furnaces has led to a great development in the business. A night shift was started some time ago, but the works being too small to deal with the orders booked, they have now been enlarged. The alterations include the provision of more room both for storage and for building furnaces, also a loading way is being built to facilitate the rapid handling and despatch of the large consignments he is now sending out. More men can now be employed both on the day and night shifts. We understand that the orders now on hand include furnaces for many British firms as well as for various firms in France, Sweden and Russia; several of the furnaces are for repeat orders.

Owing to the rise in the prices of raw rubber, Messrs. Dr. Heinr. Traun & Sons, London agency, have issued a notice to the trade advancing their prices for ebonite sheets, rods, tubes, and other lines.

Bankruptcy Proceedings.—H. G. Nicholson.—A sitting was held of the London Bankruptcy Court on Friday, November 19th, before Mr. Registrar Linklater, for the public examination of Mr. Hugh Godfrey Nicholson, who was the managing director of the British Electric Equipment Co., Ltd., which went into liquidation in April, 1907. The receiving order was made last September upon the petition of a creditor, the act of bankruptcy alleged being that the debtor on May 20th and 25th, 1909, gave notice that he had suspended, or was about to suspend, payment of his debts. Mr. A. H. Partridge, chartered accountant, 2, Gresham Buildings, Basinghall Street, E.C., has been appointed as trustee to administer the estate in bankruptcy. Questioned by Mr. Daniel Williams, Official Receiver, the debtor stated that in November, 1903, he and his brother purchased an engineering business, carried on in the name of the Britannia Co., at Colchester, and transferred it to a company formed by them in the name of the "Britannia Engineering Co., Ltd.," with a nominal capital of £40,000, afterwards increased to £70,000. Witness acted as a director of the company until it went into liquidation in December, 1907, and was subsequently occupied in negotiations for the reconstruction of the company; these had now been abandoned, and the shares were worthless. In 1904 witness agreed to purchase an electrical engineers' and contractors' business, in which he had been engaged as chief engineer since 1902, and on November 11th, 1904, he formed a company in the name of the "British Electric Equipment Co., Ltd.," with a nominal capital of £40,000, to which he sold the business for £15,216, which was satisfied as to £7,216 in cash, and as to £8,000 in fully paid shares. Witness acted as managing director at a salary of £1,000 a year, until a compulsory winding-up order was made against the company on April 16th, 1907. He attributed his insolvency entirely to the failure of the Britannia Engineering Co., Ltd., and to depreciation in the value of the securities in the hands of the creditors. The examination was concluded. Mr. A. H. Partridge, the trustee, was present in person.

Eric Eaton, electrical engineer, 36, Alexandra Road, Ashton-under-Lyne.—This debtor attended the Town Hall, Ashton-under-Lyne, last week, for his public examination before Mr. Registrar Hall. Debtor ascribed his failure to bad trade, losses on contracts, and want of capital. Through lack of capital he had lost cash discounts of 5 per cent. and 7½ per cent. The result of the bad cotton trade was that his customers could not pay, and were therefore averse to spending money on electrical fittings. His customers asked for longer credit, and when he asked for payment they were offended, and refused to give him further work. The contracts he lost money on, were undertaken in the beginning of his career, when he had not had experience in tendering for contracts. In reply to Mr. Ives with reference to the firm of Eaton & Co., debtor stated that his sister was one of the partners. He was employed by this firm as manager. Debtor was eventually allowed to pass.

Herbert Shuttleworth, electrical engineer, Briggate, Leeds.—A first and final dividend of 2s. 5d. is payable on November 30th, at 24, Bond Street, Leeds.

Private Meetings.—R. E. Walker, 16, Widemarsh Street, Hereford, electrical engineer.—A meeting of the creditors of the above was held a few days ago, when a statement of affairs was presented, showing unsecured liabilities amounting to £193, all of which were due to trade creditors. With regard to the assets, these were estimated to produce £149, or a deficiency of £44. It was reported that the debtor came to Hereford from Manchester about two years ago. He was employed by a local firm at a salary of £2 a week, out of which he saved £70, and then started to trade for himself in a small way from his private house. A few months ago he removed to his present address, where he also added a cycle dealer's business. His present position had been brought about by this venture, as he knew nothing about the trade, and had lost a considerable amount by inexperienced buying. The household furniture was claimed by the debtor's wife, who had also advanced her husband a sum of about £40. Some few months ago the debtor was joined by a Mr. Vickery, who introduced £160, this being the estimated amount of the stock at that time. The sum of £18 10s. shown in the statement was the amount over and above the £160 found to belong to the debtor when stock was taken. It was reported that a sum of £102 had been offered for the debtor's share of the business. This offer was conditional upon the debtor agreeing not to start in opposition within a radius of 20 miles for three years. A deed of assignment had already been executed, with Mr. T. B. V. Wilmshurst, accountant, of Broad Street, Hereford, as trustee. No resolutions were passed at the meeting, although it was said by the trustee that under the deed there would be a composition of at least 12s. 6d. in the £, payable almost at once. The following are the creditors:—

Edlin, Sinclair & Co.	£24
Simplex Conduits, Ltd.	20
Veritys, Ltd.	17
Ravenscroft, Richards & Co.	10
Walker, Mrs.	40

Charles F. Wood, trading as Wood, Wall & Co., electrical engineers, Hagley Road, Stourbridge, late Union Street, Wednesbury.—A meeting of the creditors of the above was held on the 18th inst. at Birmingham, when a statement of affairs as at November 5th last, was presented. This showed liabilities amounting to £451, all of which were due to trade creditors. An offer was made of a composition of 5s. in the £, satisfactorily seconded, and this offer the creditors decided to accept.

Dissolutions and Liquidations.—Joseph Richmond and Co., Ltd., Kirby Street, Hatton Garden, London.—A second dividend of 2s. is payable on and after December 6th, at 2, Clement's Inn, Strand, W.C.

Smoke Preventer Co., Ltd.—A meeting is to be held at Manchester on December 28th to hear an account of the winding up from the liquidator (Mr. Thomas Seed).

Phosphor Bronze Co., Ltd.—A petition for winding up this company, lodged by several creditors, is to be heard on November 30th.

Catalogues and Lists.—Messrs. Alfred Herbert, Ltd., Coventry.—Copy of the eighth edition of the firm's catalogue, describing and illustrating in the course of some 20 pages the "Coventry" patent self-opening die head in sizes ½ in. up to 4½ in. Full instructions for grinding the dies are given.

Messrs. Simplex Conduits, Ltd., Garrison Lane, Birmingham.—Well-bound catalogue—the eleventh annual edition—of close upon 400 pages, in which we are informed—we have not counted!—there are given 1,500 illustrations and 10 times as many prices. The range covered, in addition to the Simplex system of steel conduits and various accessories appertaining thereto, comprises all types of electrical accessories required for complete lighting installation. To facilitate reference, the list is divided up into sections, each dealing with a particular class of apparatus. The catalogue, as far as it relates to heating, cooking and electrical fittings, has been considerably extended. In regard to the former, the Simplex Co. act as sole selling agents for the manufactures of the Prometheus system, and in the sections relating to these appliances, electrical cooking and heating apparatus will be found suitable for all purposes and for a wide range of prices. A considerable portion of the catalogue is devoted to electric light fittings, and endeavour has been made to include the widest possible range, both as regards style and design, variety and price; for instance, electroliers have been listed from 10s. each to £60. More recent development of the company's business is included in the form of electricity meters; 15 separate types are listed, suitable for both continuous current and alternating current, single and polyphase.

Messrs. Ludw. Loewe & Co., Ltd., 30-32, Farringdon Road, London, E.C.—List containing illustrated information on the application of D.W.F. ball bearings to line shafting, also giving prices.

The Sun Electrical Co., Ltd., 118 120, Charing Cross Road, London, W.C.—New circular—being an advance sheet from their catalogue now in the press—showing half-a dozen designs of the "Sun" luminous-type electric radiators, and stating prices of same.

Messrs. Siemens Bros. Dynamo Works, Ltd., Tyssen Street, Dalston, N.E.—One more evidence of the enterprising spirit of this firm in making an intelligent appeal to the foreign purchaser of electric lamps, is found in the issuing of another of its series of foreign show-cards extolling the virtues of tantalum lamps. Some of the cards prepared for other markets we have already alluded to. The latest is an effort to take Italy by storm, and the design is varied accordingly. A German show-card has also been added to the series.

Messrs. Falk, Stadelmann & Co., Ltd., Farringdon Road, London, E.C.—An effective six-colour poster (20 in. × 30 in.) has been issued on which the now familiar Mephistopheles exhibits the "Efesca" metal-filament lamps. Members of the trade can have copies for posting on wall or hoarding on application to the firm, also a leaflet relating to various other advertising specialities which they hold at the disposal of customers interested in the sale of the above lamps.

Etablissements Cazes, Avenue Dubonnet, Courbevoie, France.—Card relating to their petrol-electric generating sets.

Messrs. Tetley & Co., Falcon Electrical Works, Greengate, Salford, Manchester.—Illustrated and priced leaflet giving information regarding their ironclad fuse gear—ironclad tubular power fuseboards, ironclad distribution boards, terminal type fuseboards, and switch and distribution boards.

LIGHTING and POWER NOTES.

Aberdeen.—The Corporation Electrical Department is now hiring out fans to prevent shop windows being obscured by frost. Last week was found suitable for experimenting, and a small 12-in. fan was placed at the foot of a large window in Union Street. The result was that the window, by the circulation of the air current, was kept quite clear, in strange contrast to the others which were obscured by the severe frost.

Acton.—Messrs. D. Napier & Son have asked for a quotation which would enable them to shut down their own generating plant and take all their supply from the Council's mains. The firm are prepared to give a guarantee to take one million units during the forthcoming year. The clerk was instructed to communicate with the Metropolitan Electric Supply Co. on the matter.

Ceylon.—According to *Commercial Intelligence*, the Hunupitiya Desiccating Mills at Negombo have just been equipped with an electric lighting installation. This is expected to be a great convenience to the staff who start work, shelling and shaving the nuts, long before daylight, while in the busy months work goes on practically all night. It appears that cocoa-nut shells are being used as fuel in connection with this installation.

Chipping Norton.—A local company is being formed to take over the undertaking of the Chipping Norton and District Electric Light and Power Co. It is proposed to erect a generating station in Burford Road, and the compulsory area of supply is High Street, Middle Row, Market Place, Horsefair, New Street, and West Street.

Church (Lancs.).—The U.D.C. has decided to apply for a prov. order for electric lighting.

Continental Notes.—Portugal.—During the past financial year the central stations of the Compagnies Reunies Gaz et Electricité, of Oporto, supplied current for electric lighting purposes to the extent of 4,048,560 kw.-hours—an increase of about 26 per cent. over the preceding 12 months. The energy furnished for power purposes during the same period reached a total of 1,031,829 kw.-hours, an advance of approximately 50 per cent. The report mentions that, although the number of consumers of current has increased about 30 per cent., there has not been a proportionate increase in the consumption, this being attributed to the growing use of metal-filament lamps. The new Tagus electricity generating station of the company is rapidly approaching completion. The plant comprises two sets of steam turbines and alternators of respectively 1,500 and 1,750 kw. capacity, and two sets of engines and dynamos of 750-kw. capacity. This, with the old Bona Vista station, will give the company an annual capacity of between 9 and 10 million kw.-hours per year.

Germany.—The Schlesien Electricitätswerk Gesellschaft is the name of a new company which has just been formed in Breslau, with a capital of £200,000, to establish a large central electricity generating station for the supply of energy for lighting and power purposes in the Breslau district.

Spain.—Don Alfredo Moreno Ossorio, of Madrid, has been authorised to utilise the water of the River Guadalimar, at a place called Los Piezuelos (township of Ubeda), to the extent of 5,000 litres per second, for the purpose of generating electrical energy, to be carried to La Carolina.

Crompton.—The U.D.C. has decided not to apply for a prov. order for electric lighting.

East Barnet.—The Board of Trade has revoked the 1906 electric lighting order.

Edinburgh.—An expenditure of £45,000 is in contemplation on the Dewar Place station of the City Electric Lighting Department. Sir Alexander Kennedy has prepared a preliminary report. By substituting a couple of exhaust turbines for three of the present sets, it is estimated there would be an increased output of 3½ million units per annum without any increase of cost, so far as the coal and water bill is concerned. This means the adoption of cooling towers.

Epsom.—The U.D.C. has rejected an offer from the Epsom and Ewell Gas Co. to light the streets. It was stated that the Lighting Committee after having gone very carefully into the figures, found that the promise of the company, that its offer would result in a considerable saving to the ratepayers, was not justified.

Falkirk.—The Falkirk Iron Co. has written the T.C., asking the terms on which electric light could be supplied for a portion of its works. A supply is to be given to the Camelon Co-operative Society, Ltd., the expense being estimated at £920. The Corporation expects soon to be able to lay a cable to Camelon.

Finchley.—The controversy between the U.D.C. and the L.G.B. regarding the street lighting still drags on. The L.G.B. has written affirming its decision not to grant a loan for electric lighting on the ground that information as to alternative methods of illuminating (*i.e.*, gas lighting) has not been supplied. The Council is to reply that the whole question was thoroughly gone into at the time of the L.G.B. inquiry. The Chairman said it would be as well to announce that they did not intend to use gas for street lighting.

Glasgow.—Various members of the T.C., including a recently-appointed committee, are actively interesting themselves in the solution of the problem of atmospheric purification, and a proposal has been adopted by which it is expected the comparative merits of gas and electricity as heating factors, will be experimented with in various rooms of the municipal buildings. The fogs experienced recently have emphasised the part played by the emission of smoke in the nuisance, and the following proposal by ex-treasurer Stevenson, has now been adopted by the Corporation:—"That with a view to the diminution of the smoke nuisance, it be remitted to a special committee to make arrangements for the holding of an exhibition for the purpose of showing the public the most up-to-date appliances for the utilisation of gas for lighting, heating, and cooking purposes; and that the Committee on Electricity and the Sub-Committee on Air Purification be invited to co-operate." The special committee will consist of 15 members—six from each of the Gas and Electricity Committees, and three from the Sub-Committee on Air Purification.

Gravesend.—The T.C. desires to supply electricity to Denton Hospital, and as underground mains will entail an expenditure of £300, the B. of T. is to be asked to sanction the use of overhead lines.

Haslingden.—On Friday, last week, a L.G.B. inquiry was held, and, in reply to Mr. C. E. Norton, the inspector, it was stated that with reference to the electric lighting and tramway schemes £1,300 of the amount spent on a destructor would belong to the tramways department. The electric lighting order of 1899 had not yet been exercised, and supply for the tramways was being taken from Accrington after being supplied to a regulating station. The town clerk stated that originally they arranged to take energy from the Lancs. Electric Power Co., which was afterwards unable to carry out its agreement, and as the Corporation Act of 1906 did not permit Haslingden to generate current, the Corporation made terms with Accrington.

India.—The Mysore Durbar has provided expenditure for the installation of electric lights in the extensions and the suburban villages, &c., of Bangalore City.

Leicester.—A L.G.B. inquiry was held on November 16th into the application of the T.C. for a loan of £7,000 for electricity purposes. The money is required for the supply of power from the tramway generating station. There was no opposition.

The Corporation Electrical Committee has fitted up a suite of rooms at the offices in Millstone Lane with the object of demonstrating electric lighting, heating and cooking appliances.

Lewisham.—The secretary of the South Metropolitan Electric Light and Power Co., Ltd., recently wrote to the Council suggesting that the development of the Forster Estate presented an opportunity for a trial of street lighting by electricity. The company had been favoured with a contract for the complete installation to the houses in Arran, Bellingham and Bromley Roads, and had been asked to obtain the consent of the Council for the public lighting of these. The Highways Committee of the Council points out that the proposed scheme would entail increased cost without any definite advantage. Under these circumstances, the Committee has decided not to entertain the present proposal.

London.—A new concession has been granted by the City Corporation to the Smithfield Markets Electrical Supply Co., until December, 1972, with the right of determining it in 1932 or 1952.

The Port of London Authority has decided to provide entirely new electrically-driven pumping plant for the purpose of raising the level of the water in certain docks.

Macclesfield.—The B. of T. has informed the T.C. that it will defer for a month from November 9th, the question of revoking the E.L. order. The Corporation Gas Committee has been asked to prepare a report on the question of the supply of electricity for the borough.

Mexico.—The Puebla Tramway, Light and Power Co. notifies that a formal petition has been presented on its behalf to the Government for leave to extend its electric transmission lines for light and power into Mexico City and the Federal district. This step has been rendered necessary by the approaching development of the Tuxpango Fall, which, whilst supplying the power required by the growing needs of Puebla City, will, at the same time, leave available some 25,000 h.p. for Mexico City and the surrounding district.

North Berwick.—The T.C. some time ago received notice from Messrs. Crompton & Co. that they were to ask authority from Parliament to introduce electric lighting into the town. It has been agreed to meet a representative of the company with a view to coming to terms regarding the promotion of an Order.

Pontypridd.—A L.G.B. inquiry was held on November 18th into the application of the U.D.C. for a loan of £6,424 for electricity purposes. There was no opposition.

Radcliffe.—The Lancs. Electric Power Co. has given notice of its intention to apply to the Board of Trade for a provisional order to produce and sell electricity for all public and private purposes within the urban district of Radcliffe, where the District Council already possess monopoly powers. The company proposes to lay cables within two years from the commencement of the order in the main thoroughfare of the town, and will also ask for power to break up a number of other streets.

Reading.—The Electric Supply Co. has decided to apply for powers to extend the area of supply so as to include the parishes of Caversham, Maple Durham, Tilehurst and Theale, and to supply energy in bulk in the districts of Workingham, Bradfield, Wallingford and Henley.

Stanley (Yorks.).—The B. of T. has informed the U.D.C. that the question of revoking the E.L. order, 1902, will be deferred for three months.

Walsall.—The T.C. has applied for a loan of £35,000 for electricity purposes.

West Ham.—Mr. H. H. Couzens reports an interruption of the supply on November 8th. The trouble was due to a current transformer failing, and to prevent a recurrence of the trouble, new transformers are to be obtained. The supply to the Abbey Lane sub-station is dependent on one feeder only, and although the cables in West Ham have proved very reliable, he did not consider they were justified in risking the continuity of the supply to the Stratford factory district. When the new cable supplies are laid to the Town Hall, it is proposed to extend one of these to Abbey Lane. The estimate of the cable work is £5,400. The report was adopted.

Widnes.—The T.C. has decided to negotiate with the Salt Union, Ltd., and Messrs. Merz & McLellan, who are seeking powers to supply electricity, for the transfer of the existing electricity order. Mr. J. H. Crowther has been retained to advise the Council in the matter.

Willesden.—An application from Messrs. Underwood and Bros. for permission to erect overhead mains for power and lighting supplies in connection with the Brent drainage works has been granted, subject to protective conditions. The Council is to give the combined supply of current at 2d. per unit.

Worksop.—The U.D.C. has decided to supply electricity for heating and cooking at 1d. per unit, and to reduce the price of energy where prepayment meters are used to 4½ per unit.

Ystradgynlais. — The ratepayers have accepted the tender of Messrs. Mills, English & Co., of Swansea, for carrying out the electric light scheme, by which about 130 lamps will be utilised for public lighting.

TRAMWAY and RAILWAY NOTES.

Argentina.—The *Boletin Oficial* of October 12th publishes a decree authorising the Buenos Ayres Great Western Railway Co. to extend its lines from the neighbourhood of Sadi Carnot Street to the lines of the port of the capital, passing under part of the city by means of a tunnel. Traffic on the new line is to be worked by electric traction, and the service of electric trains is to run also between Sadi Carnot and Moreno Station, the company being empowered to construct two additional lines between Caballito and Moreno. The company is obliged to set up fire-extinguishing apparatus in the tunnel. Plans of the work must be submitted for approval within 18 months from the date of promulgation of the concession, and the work must be completed within four years and six months after the approval of the plans.

The *Boletin* further contains the text of a decree granting to Messrs. Otto Franke & Co., concessionaires for the electric railway between La Plata and Avellaneda, a concession for the construction and working of an electric railway from the side of the Riachuelo to Retiro station, joining there with the existing lines; a branch line is to be constructed from Entre Rios Street, by way of Brasil Street, to Constitucion Square, and connections are to be made with the lines of the ports of Buenos Ayres and La Plata. The main line is to cross the Riachuelo by a drawbridge and to continue at the same height along a viaduct to the top of Uspellata Street, where it is to enter a tunnel. Fire-extinguishing apparatus is to be provided. Plans must be submitted for approval within 18 months from the date of promulgation of the contract, and the work must be completed within four years and six months after the approval of the plans.—*Board of Trade Journal.*

Bacup.—The T.C. has decided to apply to the Light Railway Commissioners for an order to construct a tramway from the borough and Whitworth boundaries to Bridge Street. The new line will join an existing one at Whitworth.

Belfast.—The Law Committee is to oppose the Bill which the Cavehill and Whitewell Tramway Co. is promoting for the purpose of obtaining running powers over a portion of the Corporation's system.

Bolton.—The Tramways Committee has decided to relay the route between Bromwich Street and Portugal Street with a double track. The question of the adoption of half-penny fares has been adjourned to the next meeting of the Committee.

Canada.—The Toronto Railway Co. is now using two motor vehicles in connection with the maintenance of its electric tramway system in Toronto, Canada. One of them is a Berna 3-ton petrol motor-lorry, fitted with a tower and ladders for repairing the overhead wires, while the other is an ordinary pleasure car, the body of which has been replaced by a platform to carry the ladders necessary for wire repairing work.

According to the *Standard*, reports are once more current that the Canadian Pacific intends to electrify some part, at any rate, of its system in the Rocky Mountains. The first experiment is to be made next summer, on the branch line into Phœnix, which will be run with power supplied by the West Kootenay Power and Light Co., in which the C.P.R. is supposed to be interested. The Southern Pacific has electrified a portion of its system with success on the Sierra Nevada division, where the conditions are very similar.

Chile.—Following the article which appeared on page 805 of our last issue, from a newspaper cutting just received it appears that the Chilian Government is in favour of the Italian Westinghouse Co.'s scheme, and that His Excellency, President Moutt, is anxious to proceed with this important reform as soon as possible. The Government will shortly bring the matter of railway electrification up in Congress for consideration.

Continental Notes.—Russia.—The preliminary survey of the projected new electric railway between St. Petersburg and Imatra is almost completed. The necessary deposit has, according to the *Novoe Vremya*, been paid into the Imperial Bank, and the funds for the construction of the line are assured. The Vuocks River falls will be used to generate the necessary electric power.

France.—Nineteen persons were injured in a tramway accident which occurred in the fog, at Vitry, near Paris, on Monday.

Denmark.—According to the *Financial News*, negotiations have for some time been in progress between an English financial and an English electric firm, on the one side, and some towns and municipalities in Jutland, Denmark, on the other, concerning the construction of an electric railway between the towns of Aarhus and Randers, which is calculated to cost some £200,000, and of electric central stations for the purpose of supplying a good-sized district with electric current for power and light, which may entail an expenditure of rather more than £150,000. The loan, probably of £400,000, will be guaranteed in various ways.

Germany.—Work is about to be commenced on the construction of an electric tramway between Dresden and Klotzsche.

Italy.—Consideration was given at a recent meeting of the Municipality of Belluno, to the project for the construction of an electric railway over the Dolomite Alps. The Construction Committee reported that a private company had offered to construct the Agordino section at its own cost, and had applied for the Government's sanction. After long discussion, it was decided to decline that offer, and to take steps to raise within the province an initial capital 50,000 lire, for the purpose of purchasing the scheme of the Engineer Baudracco, payment for which will be made in two portions—three-fifths at once, and the remainder after obtaining the Government's approval of the project.

A scheme for an electric aerial railway appears, says the *Giornale dei Lavori Pubblici*, likely to be shortly realised. It will be of a length of 13·300 km., and will ran from Prato Sesio to Borgomenero, touching Cavallirio, Boca-Maggiore and Vergano *en route*. It will be worked by an electric plant at Boca, where three-phase generators will produce energy at 350 volts, which will be distributed by aerial lines.

Application has been made by the Società Varesina per Impresse Elletriche for leave to build and work an electric tramway from Varese to Bobbiate. The line will have a length of 3·418 km., the gauge being 1 metre.

Concessions for electric tramways between Mestre, Treviso and S. Artemio, and between Trani and Corato, have been sanctioned by the Italian Public Works Department, the granting of a yearly subsidy of 1,500 lires per km. for 50 years being also approved in the latter case.

Consent has been accorded to the application made by the Società dei Tramways Fiorentini for a concession to construct and work an electric tramway from Badia to Ripoli and Grassina, being an amplification of the existing lines between Florence, Bagno and Ripoli. The new line will have an extent of 4·230 km.

Devonport.—The Devonport and District Tramways Co. has written to say that the leased lines will be re-opened for public traffic as soon as they can be got ready. The company having given notice to apply to Parliament for a Bill to amend the terms of the Acts of Parliament and lease relating to the leased lines, the town clerk was instructed to to take steps to oppose the Bill and retain counsel and Parliamentary agents.

Doncaster.—Another tramway extension, to the colliery village of Warmsworth, is being promoted by the T.C. The length is 2,330 yards, and the estimated cost £11,600.

Dundee.—The Tramways Department is going to try vestibules on tramway cars for the protection of the drivers and conductors.

Falkland.—The B. of T. has confirmed the Falkland Light Railway (Extension of Time) Order, 1909.

Fife.—The Wemyss Tramway Co. is to apply for a prov. order authorising the construction of tramways in the burghs of Kirkcaldy and Lochgelly, and also in a number of adjoining parishes.

Haslingden.—The earnings of the electric tramways per car-mile from April 1st to October 31st were equal to 11·20d.; during October they were 11·48d. compared with 11·54d. in September. The passengers carried during the seven months were 658,858.

Llandudno.—A settlement has been arrived at in the action brought by the U.D.C. against the Llandudno and Colwyn Bay Electric Railway Co. for the interpretation of the agreement between them. This agreement fixes the scale of prices to be paid to the Council for energy for working the tramway. The omission of the words "per annum" in certain cases led the company to contend that, the minimum consumption being once passed, only the lower rates were chargeable against them in subsequent years, while the Council held that the scale should come into operation afresh each year. The terms of the compromise show that the company have assented to the Council's construction of the agreement, but that there is to be no payment to the Council on the basis of that construction until after the date of the settlement. A further condition assented to by the Council is that it will revive a former offer to take a poll of the town on the question of Sunday running, subject to the expense of the poll being borne by the company. The plebiscite is to be taken whenever the company give a month's notice of their desire that it shall be proceeded with, but it is not to be done during the visiting season. It is also stipulated that a sum is to be paid to the Council in respect of costs incurred in connection with this action.

London.—It is proposed to amalgamate the Piccadilly, Bakerloo and Hampstead tube lines, but, as the *Financial Times* remarks, the amalgamation will be largely in the nature of a family affair, as practically all the ordinary stock of the companies, amounting to £11,100,000, is held by the Underground Electric Railways Co., which will own the joint undertaking. The capital of the new concern will be £16,800,000, and the total issue of the three companies amounts to £15,920,000. The extra capital is to be spent, among other things, on a junction between the Bakerloo and Hampstead lines.

The Highways Committee of the L.C.C. has come to an arrangement for through running from Aldgate *vid* Stratford Broadway to Ilford Broadway and to Epping Forest. This service will involve agreements with the West and East Ham Corporations and the Leyton U.D.C. It is proposed that each authority shall take all fares on its own cars, pay its own working expenses for operating its own cars, supply electrical energy in its own area to the other authorities and run cars according to the length of track in its own area.

The Brighton Co. has decided to commence a public service on its electrical route—to be known as the South London Elevated Electric—on December 1st. The journey, London Bridge-Victoria, is timed to take 24 minutes, as against 36 minutes with the steam trains; the fares are to be reduced, and, in consequence of the frequent electric service, many through-train stoppages will be eliminated.

It is reported that the Sydenham, Victoria and West End Electric Tube Railway Syndicate will not proceed with the Bill until after the General Election.

Northampton.—The T.C. has decided to apply for Parliamentary powers to enable it to extend the tramways from the centre of the town to the outlying district of Far Cotton. Recently the Tramways Committee sent a deputation to Germany to inspect several installations of the trackless trolley system, and the deputation also visited Hendon and inspected the system there. It came to the conclusion, however, that the trackless system is unsuitable for the Far Cotton route, on which there is a very steep incline. Excluding the cost of the application for powers, the capital outlay for the extension is estimated at £14,040, this sum including the purchase of four new cars and the widening of a bridge over the River Nen. The annual outlay is estimated at £2,650, made up of redemption of capital and interest, £850; and working expenses, £1,800. The receipts are estimated at £2,450, leaving a deficiency of £200. At present the Far Cotton district has an omnibus service which is run at an annual loss of £450. Several members of the Council expressed the opinion that electric cars would pay from the commencement. The only opposition to the application for powers is expected to come from the L. and N.W. Railway Co., whose Northampton to Peterborough line is carried over a level crossing on the tramway route.

Perth.—The Convener of the Tramways suggests that an expert be called in to report as to how the system could be improved. Among other proposals is one to separate the offices of traffic superintendent and electrical engineer; Mr. Lambert to be responsible for the latter duties, and to proceed with the erection of a new depôt in South St. John's Place.

Wakefield.—The B. of T. has refused the application of the Wakefield and District Light Railway Co. for the abandonment of certain sections of the proposed tramways in the outlying districts of the city, but has extended the time for completing the lines to November, 1911.

TELEGRAPH and TELEPHONE NOTES.

Aberdeen.—The National Telephone Co. has transferred the working of its system from the old exchange to a new one in Bon Accord Street.

Argentina.—The "Empresa Telefonica del Chubut" has obtained a 30 years' concession for the establishment and working of a public telephone service between Rawson, Trelew, Puerto, Madryn and Gaiman.—*Board of Trade Journal.*

The American Combine.—Mr. C. H. Mackay, president of the Mackay Companies, has issued a categorical denial of the existence of any connection with the combine; he declares that his companies had nothing whatever to do with it, and knew nothing about it until the public announcement was made.

Canadian Telegraph Rates.—On the 1st prox. an increase in the rates for code telegrams comes into force in Canada. Owing to the difficulty in transmitting code words, such words are to be limited to five letters in all landline telegrams between Canada and the U.S.A.

Communication with Trains.—The American Press reports that successful experiments have been made with a third-rail system of telephonic communication with moving trains on the Erie line. The automatic stopping of trains moving towards one another on the same track was also effected.

Overhead Telephone Wires.—Mr. Garrett, at the West London Court, recently gave his decision in a dispute between the Postmaster-General and the Hammersmith Borough Council in respect of the desire of the Post Office to place overhead wires and telephone posts throughout the borough of Hammersmith. The decision was in favour of the Postmaster-General.

Telegraphic Interruptions. — Heavy snowstorms towards the end of last week, combined with severe cold, seriously interfered with telephonic and telegraphic communication in Germany, and almost cut off communication with other countries.

West Indies.—The condition of West Indian communications remains unaltered. The c.s. *Relay* was expected to arrive at Jamaica this week, and would immediately proceed to repair the Turks Island-Jamaica cable. Messages are still being sent by post between New York, Cuba, Bermuda and Jamaica, and the islands beyond and from there by cable to destination.

Wireless Telegraphy.—A contract has been entered into between the Compania Espanola de Telagrafia sin Hilos and the Government whereby wireless telegraph stations on the French Berthenod system will be set up at Cadiz, Vigo, Barcelona and the Balearic and Canary Islands, including six of the principal of the last-named, which, with the Santa Cruz de Teneriffe and Gando stations, will embrace a radius of 2,500 kilometres, thus establishing communication with Cape Verde, and thence with Pernambuco in South America. The company has just completed the erection of its station at Santa Cruz.

Colonel C. C. Wilson, of New York, president of the United Wireless Telegraphy Co., has come to this country to secure the sanction of the Postmaster-General for establishing a number of wireless stations in England, which he proposes to use for inland as well as for ocean purposes. He is said to have made the ridiculous statement that within five years the cable companies would be driven out of business!

CONTRACTS OPEN and CLOSED.

OPEN.

Australia. — Melbourne. — November 29th. 1,250 opalescent arc lamp globes for the Council. See "Official Notices" November 12th.

Melbourne.—December 6th. 230 A.C. and 160 D.C. electricity meters for the Council. See "Official Notices" November 19th.

Melbourne.—December 8th. 4,508 yards of single-conductor lead-covered cable, and 1,500 yards three-core lead-covered cable. See "Official Notices" to-day.

Melbourne.—December 13th. 50,750 incandescent lamps for the City Council. See "Official Notices" to-day.

Melbourne.—January 5th. One feed-water oil eliminator for the City Council. See "Official Notices" November 19th.

Melbourne.—February 22nd, 1910. The Postmaster-General is calling for tenders for the erection of wireless telegraph stations on North and South Heads, Sydney, and on Fremantle Heights, Western Australia, capable of communicating with ships up to 1,000 miles.

March 16th, 1910.—A Branching multiple magneto switchboard for the P.M.G., for Canterbury, Victoria. Commonwealth Offices in London, 72, Victoria Street, S.W.

Belgium.—December 31st. The municipal authorities of Jupille are inviting tenders for the concession for the lighting of the little town by gas or electricity.

January 31st.—The municipal authorities of Waremme are inviting projects for the establishment of a central electric station in the town.

Cape Colony.—December 6th. Electric lighting proposals for the town, for the municipality. It will be observed that the time for submitting schemes is very short. The *Board of Trade Journal* gives a few further particulars.

Cape Town.—January 5th. The Corporation are requiring tenders for the supply of motors for the year 1910. These motors are in connection with the hire-purchase system commenced by the Corporation two years ago. Tenders to City Hall, Cape Town.

Dublin.—November 29th. General stores for the Dublin United Tramways Co. (1896), Ltd. See "Official Notices" November 5th.

December 1st.—Electric wiring and fitting of the Workhouse buildings, nursing sisters' residence, and North City Dispensaries, for the North Dublin Board of Guardians. Specifications at the office, North Brunswick Street, or from the consulting engineer, L. J. Lawless, 27, Castlewood Avenue, Rathmines, on payment of the cost of production.

Durham.—December 13th. Stores, including electric fittings, for the Trimdon Grange Colliery Co. (Walter Scott, Ltd.), Durham.

Glasgow.—Messrs. Wm. Barr & Sons (Coal Masters), Ltd., are inviting tenders for stores, &c., for the year 1910, for several of their collieries. Schedule "O" is for electric fittings. Forms of tender at the offices, 10, Bothwell Street, Glasgow.

India.—LUCKNOW.—December 31st. The Municipal Board invites proposals for supply of electrical energy, coal or oil gas. See this column for October 29th, and an article in our last issue.

Italy.—December 6th. The Italian Naval authorities in Spezia are inviting tenders for the supply of a number of electric searchlights for use on warships.

Middleton.—December 7th. Coal for the Corporation electricity works; Mr. S. Pauls, electrical engineer.

Neath.—2,000 tons of coal for electric generating station. Mr. G. H. Thomson, electrical engineer, Green Street, Neath.

Poplar.—December 8th. Electric fan and fittings for the Workhouse Laundry. See "Official Notices" to-day.

Russia.—March 14th, 1910. The municipal authorities of Samarkand are inviting tenders for the concession for the construction and working of eight kilometres of electric tramways in the town.

Spain.—December 10th. The municipal authorities of Tabernas (Province of Almeria) are inviting tenders for the concession for the electric lighting of the town during a period of 10 years.

The Direccion de Telegrafos has been authorised to acquire 400 kilogrammes of covered wire, 20 metres of type B cable, and 4,000 metres of aerial telephone cable, with 28 conductors.

CLOSED.

Australia.—MELBOURNE.—According to an exchange, the tender of Messrs. Pfaff, Pinschof & Co., Pty. Ltd., Melbourne, at £340, for 80 A.C. flame arc lamps of the "U.V." type, has been accepted by the City Council.

Bolton.—The tender of Messrs. Dick, Kerr & Co., for 10 electrical equipments for cars, also that of Messrs. Hadfield, for points and crossings, have been accepted.

Doncaster.—The T.C. has accepted the tender of the United Electric Car Co., for four top covers for tramcars, at £91 each, and alterations to staircases, at £24 16s. per car; that of Messrs. J. Butler & Co., Halifax, for a shaping machine, at £80 10s. 8d.; and that of Messrs. Hall & Son, for a steam feed pump, at £86.

Government Contracts.—During the past month the following tenders have been accepted by the Government Departments named:—

ADMIRALTY.

Incandescent lamps.—Edison & Swan Co., Ltd.; General Electric Co., Ltd.
Lamp fittings.—McGeoch & Co., Ltd.
Telegraph gear.—Chadburns (Ship) Telegraph Co., Ltd.

GENERAL POST OFFICE.

Cable, india-rubber and cotton cov.—W. T. Henley's Telegraph Works Co., Ltd.
Cable, paper cov.—British Insulated and Helsby Cables, Ltd.; Johnson and Phillips, Ltd.; Western Electric Co.
Dry cells.—Siemens Bros. & Co., Ltd.
Unmounted generators.—International Electric Co.
Paper, Morse and Hughes.—Colley's Patents, Ltd.
Bronze wire.—T. Bolton & Sons, Ltd.; British Insulated and Helsby Cables, Ltd.; Shropshire Iron Co., Ltd.; F. Smith & Co., &c., Ltd.
Battery equipment and main switchboard installation at the Head Post Office, Bristol.—Westminster Engineering Co., Ltd.
Telephone trunk service equipment installation at Post Office trunk exchange, Sheffield, and at Post Office trunk exchange, Bristol.—British Insulated and Helsby Cables, Ltd.

Heywood.—The Rochdale Electric Co., Ltd., have secured the Government contract for the electric lighting of the Post Office at Heywood.

London.—L.C.C.—The Education Committee received the following tenders for electrical work at the Paddington Technical Institute:—

Deane & Boal, Ltd.	(accepted)	£287 10
G. and E. Bradley		309 10
J. and F. May		348 10
Strode & Co.		397 0

The Switchgear Co., Ltd., whose tender, at £3,517, for high and low-tension switchgear was recently accepted, informed the Council that an error occurred in their estimate. This the Highways Committee reports will make their tender higher than those of two other firms. The acceptance of the tender of Johnson & Phillips, Ltd., at £3,625 is therefore recommended.

SOUTHWARK.—The B.C. has accepted the following quotations:—

Siemens Bros.—8 H.P. motor, £37.
Crompton & Co., Ltd.—3 KW. converter and starter, £45 18s. Two 5 KW. converter machines (in place of two 3-KW. machines previously ordered) £117.

Rugby.—The U.D.C. has accepted the tender of the British Thomson-Houston Co., Ltd., for the electrical equipment of the laboratory at the Lower School.

Shanghai.—We understand that Messrs. Cryselco, Ltd., of Bedford, manufacturers of the "Cryselco" carbon and metal-filament lamps, have received the contract for the supply of lamps to the Shanghai Municipal Council for the ensuing 12 months.

Wallasey.—The tender has been accepted of Messrs. Imeson, Finch & Co., of Stockton-on-Tees, for work in connection with the extension of the tramways a distance of 3½ miles.

Watford.—The U.D.C. has accepted the tender of Messrs. Siemens Bros., Ltd., for a year's supply of meters.

Worksop.—The U.D.C. has accepted the tender of Bell's Asbestos Co., Ltd., for asbestos non-conducting boiler covering, at 10s. per cwt.; and that of Mr. Hadyn Harrison for 200 Osram lamps for street lighting, at 3s. 1d. each.

FORTHCOMING EVENTS.

Northampton Institute Engineering Society.—Friday, November 26th. At 5.45 p.m Paper on "Single-Phase Electric Traction," by Mr. T. A. Collett.

Physical Society.—Friday, November 26th. At 5 p.m. At the Imperial College of Science, South Kensington, S.W. Paper on "The Effective Resistance and Inductance of a Helical Coil," by Mr. J. W. Nicholson; and other papers.

Association of Engineers-in-Charge.—Saturday, November 27th. Social. Dance.

Institution of Electrical Engineers (Manchester Section).—Tuesday, November 30th. At 7.30 p.m. At the University, Manchester. Paper on "Recent Developments in High-Tension Transmission on Overhead Lines," by Prof. E. W. Marchant and Mr. E. A. Watson.

Faraday Society.—Tuesday, November 30th. At 8 p.m. At the I.E.E. Annual general meeting, followed by ordinary meeting. Papers "On the Electro-Analytical Determination of Lead as Peroxide," by Mr. H. J. S. Sand; "On the Influence of Dissolved Gases on the Electrode Potential in the System Silver-Silver Acetate, aq.," and "Contributions to the Study of Ionisation in Aqueous Solutions of Lead Acetate and Cadmium Acetate," by Mr. A. Jaques.

Institution of Civil Engineers.—Tuesday, November 30th. At 8 p.m. Further discussion on papers on "Railway Electrification."

Friday, December 3rd.—At 8 p.m. Students' meeting. Paper on "The Design of Generating Stations," by Mr. G. Ingram.

Institution of Electrical Engineers (Birmingham Section).—Wednesday, December 1st. At 7.30 p.m. At the University, Birmingham. Papers on "Research on Metallic-Filament Lamps," by Mr. F. H. R. Lavender; and "The Present Aspect of Electric Lighting," by Messrs. H. W. Handcock and A. H. Dykes (to be taken as read and discussed).

Institution of Electrical Engineers (Students' Section, London).—Wednesday December 1st. At 7.45 p.m. At 9a, Victoria Street, S.W. Paper on "Special Rheostats," by Mr. J. S. Messent.

Institution of Electrical Engineers (Glasgow Section).—Wednesday, December 1st. At 6.30 p.m. for 7 p.m. At the Grosvenor, Glasgow. Annual dinner.

Rontgen Society.—Thursday, December 2nd. At 8.15 p.m. At 20, Hanover Square, W. Paper on "Some Effects of Electrical Discharges on Photographic Plates," by Prof. A. W. Porter.

Institution of Electrical Engineers (Glasgow Students' Section).—Friday, December 3rd. At the Technical College, Glasgow. Discussion on "The Training of an Electrical Engineer," led by Messrs. F. A. M'Gowan and G. G. Cree.

THE ELECTRICAL ENGINEERS (LONDON DIVISION).

THE following orders are issued:—

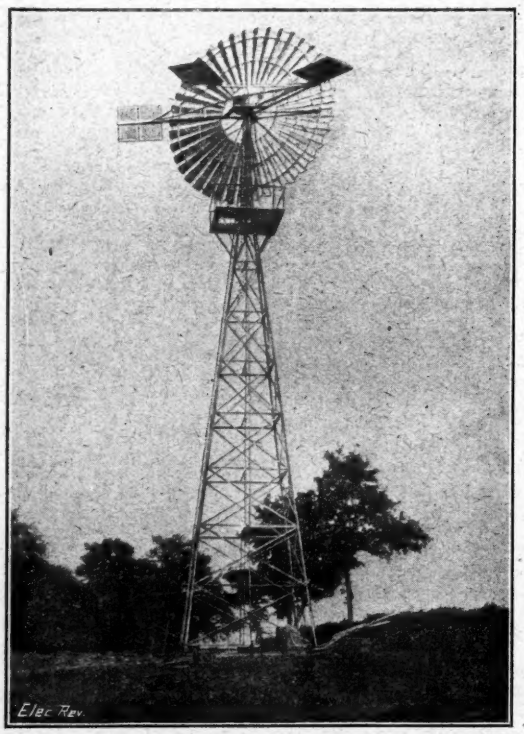
Commanding Officer—COL. R. E. B. CROMPTON, C.B.

Monday, November 29th.—"A" Company. Technical drill, 6.30 to 9.30 p.m
Tuesday, November 30th.—"B" Company. Technical drill, 6.30 to 9.30 p.m
Wednesday, December 1st.—Gymnasium, 6.30 to 9.30 p.m.
Thursday, December 2nd.—"C" Company. Technical drill, 6.30 to 9.30 p.m
Friday, December 3rd.—"D" Company. Technical drill, 6.30 to 9.30 p.m
Saturday, December 4th.—"C" Company. Week-end run at Coalhouse Fort suspended until December 11th.

(Signed) P. H. CAMPBELL, Capt. R.E. and Adjutant
For O.C. E.E., L.D.

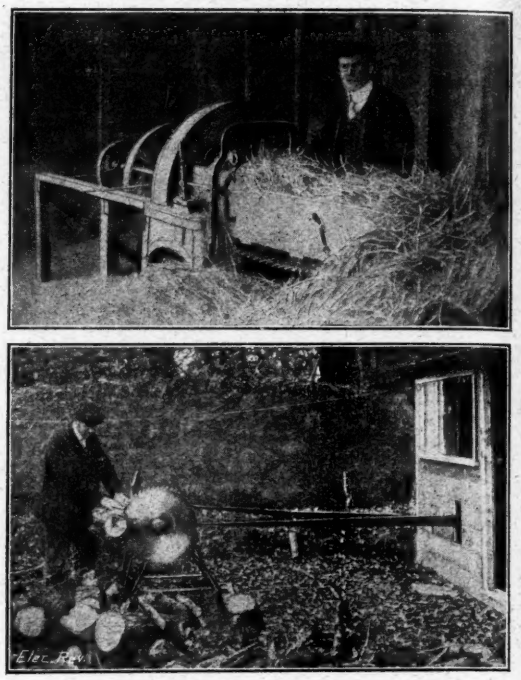
NOTES.

A Country House Wind-Turbine Electric Plant.—An interesting installation has been put in at Buckenhill, Bromyard, Herefordshire, the residence of Mr. R. Phipps, by Messrs. J. G. Childs & Co., Ltd. The motor is one of their standard wind turbines for electric driving, 24 ft. in diameter, and is mounted upon a steel tower 75 ft. high, about 435 yd away from the house, on ground which stands perhaps 90 ft. above the level of the ground round the house. The generator is placed in a small house at the foot of the tower, and the battery and switchboard are mounted in one of the outbuildings of the house. The current is conveyed from the generator to the battery by means of bare copper cables, carried on porcelain insulators mounted on poles, in connection with which lightning arresters are fixed. The generator is of a special design, with a speed variation of 400 to 1,600 R.P.M. and runs with the armature in a vertical position. It is carried on ball bearings, and is driven by a 5-in. belt from the vertical shaft of the wind turbine. The generator is of 4 KW. capacity, with a normal voltage of about 70. In order to have the whole of the control arrangements in the battery room, a separate field wire is carried up to the battery along with the other conductors. The battery consists of 28 cells by Messrs. Pritchetts & Gold, having a discharge capacity of 46 amperes for 10 hours, and is divided into two equal groups, either of which can be used for the lighting circuit, which is fed at 25 volts, using Osram metallic-filament lamps. Arrangements are made for using 50 volts for power, as the plant in addition to running the lights in the house (about 100 in all) also drives a 50-volt motor for running a chaff cutter, circular saw, and root-pulping machine. This motor is placed in a shed about 80 yd. from the house, and is connected to the battery by means of an armoured lead-covered cable laid in the ground. The chaff-cutting required for the homestead is easily dealt with by this machine, and also a considerable amount of firewood, &c., is sawn. The motor is belted direct to the various machines, and, of course, only runs one at a time.



WIND TURBINE AT BUCKENHILL.

We are informed that the plant has now been running for over a month, and behaves admirably. It is entirely automatic, being fitted with Messrs. Childs's patent tail gear, which gives very accurate adjustment to the wind. This arrangement consists of three tails, two of which stand out at about 20° with the wheel. Two of these are connected together, so that when the wheel is required to stop, these have only to be pulled into a horizontal position, and the wheel immediately comes up into the wind and stops running. In the same way the tails are so balanced, that when the wind reaches a predetermined velocity the tails tend to take the horizontal position, and so bring the wheel out of the wind more or less as the strength of the wind varies. In the recent gale which swept over the Midland Counties, this plant underwent a very severe test of stability; though a very large tree was blown down close to it, the wind turbine suffered not the slightest harm. It is found that the supply from the wind turbine is very reliable, and the plant requires very little attention. All the main bearings carrying load are ball bearings, and the gear is enclosed in a cast-iron oil bath, so that if the plant were left for 12 months no harm would result from want of lubrication. As the wind turbine is placed on ground somewhat higher than the house, there is often a good wind blowing at the turbine, when none is felt down at the house. The plant is guaranteed to produce 3,000 units a year, but in practice it produces at a much faster rate than this. In 12 hours

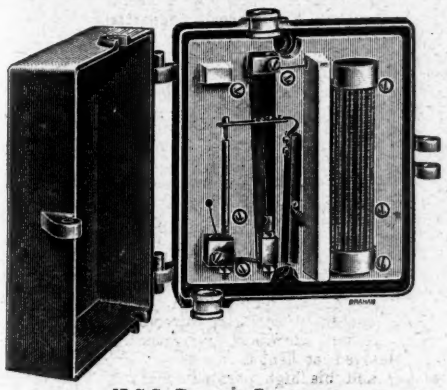


CHAFF CUTTER AND SAW DRIVEN BY WIND POWER.

recently it produced 14 units, with wind averaging 15 miles an hour. Estimating that the average wind in this situation will be about 9 miles an hour, the output of the plant in a year will probably be about 5,000 units.

The Development of Electrical Main Line Traction.—In a paper recently read by Dr. Eichberg at the Allgemeine Elektricitäts Gesellschaft's Works, in Berlin, the present position of electricity in connection with main-line railway work is discussed. He points out that the spread of heavy electric traction has not been nearly so rapid as that of electric tramways, chiefly because the economical advantages of heavy electric driving are more immediately evident in special cases, such as those where the traffic is unusually dense, or the gradients very heavy, where long tunnels have to be traversed, or where there is a possibility of employing water-power. The other advantages of electric driving, such as absence of smoke, do not appear to be appreciated yet in Europe, although, in America, the tendency now is towards prohibiting the introduction of steam traffic within the bounds of the towns. The first main-line electrical experiments were made in 1894 on the Baltimore-Ohio line. Since 1907 all the trains of the New York Central Railway have been brought into the New York terminus by means of electric locomotives, and similar applications of electric driving are also in use on the Paris-Orleans line, and in Italy on the Milan-Gallarate line. As long as the use of direct current is retained, the collection of the current is practically confined to the third-rail system, and this is looked upon with unfavourable eyes by the railway authorities from the point of view of track maintenance. In Italy, and also in connection with the German high-speed trials, a three-phase supply was employed. The higher voltage thus made available permits overhead collection to be retained and long distances to be dealt with; but, although this system has proved itself quite practicable, the fact that two overhead lines, with a large voltage difference between them, are necessary, is a serious drawback. The difficulties are especially great at crossings and points, and have led to the general demand amongst railway authorities all over the world for the use of some system involving the installation of only one overhead line. Since 1903 this demand has been met by the development of the single-phase commutator motor. These were first used on the Niederschöneweide-Spindlersfeld trial line. They were then adopted in Hamburg, to which city the A.E.G. has supplied no fewer than 79 double cars of this type, and the practicable nature of this solution under normal working conditions has since been fully confirmed by the experience of numerous railways. There is now hardly any large European railway which is not concerning itself with the question of electrifying some portion of its system, and there can be little doubt, in the opinion of Dr. Eichberg, that the next few years will see important developments in this direction.

N.C.S. "Limiter."—A simple device has been introduced by Messrs. Nalder Bros. & Thompson, Ltd., of Queen Street, E.C., for use in connection with the current-limit system of charging for electrical energy. As shown in the accompanying illustration, it consists of a resistance and a thermal cut-out, mounted on a slab of porcelain and enclosed in a cast-iron case. It is suitable for both A.C. and D.C. circuits without modification. The thermal cut-out is made of three iron parts—a fixed bar, carrying at the upper end a contact spring with adjusting screw; a wire traversed by the main current; and a pillar, upon the upper end of which the contact is made. Normally the resistance, which is of the woven-wire type in cylindrical shape, is short-circuited by the cut-out; but when the predetermined limit of consumption is exceeded, even by 20 watts, the expansion of the wire



N.C.S. Demand Limiter.

due to its rise of temperature opens the contact, and throws the resistance into circuit. The resulting diminution of current strength allows the contacts to close again, and the lamps therefore continue blinking until the excess of current is cut off. The apparatus is unaffected by ordinary changes of temperature, owing to the above-mentioned construction of the chief parts of the same material (iron). The device is of interest in connection with Messrs. Handcock & Dykes's paper, read at the I.E.E. last night.

Electric Shock Fatality.—On the 19th inst. an inquest was held into the death of Robert Hall, 27, signalman, in the electrical department at Denby Colliery, who met his death from electric shock, on 10th inst, underground. The inquest had been adjourned to allow investigations to be made by the Government electrical expert, Mr. Robert Nelson, who was now present.

Daniel Taylor, a corporal at the colliery, stated that on the day of the accident deceased came down the incline with an empty tub, out of which he took some tools and entered the haulage house. Witness was 15 yards away at the time, and had only gone another 7 yards when he heard a lamp fall in the haulage house; on getting no reply to his shout he hurried to the door, and there saw deceased just falling down, with the appearance of clutching at something. At the same time some sparks and a bright flash were twice in quick succession emitted from the ammeter. Witness hailed the deputy, and then ran to get the power cut off. Deceased would only be in the house half a minute before witness heard the lamp fall, and would have had no time to do any work there.

William Hannah, of Belper, electrician at the colliery, said the plant was new, and had only been worked for trial purposes. They had earth plates to which the cables were connected, and as far as he knew at the time of the accident they were satisfactory, frequent tests having lately been made. On the 15th, whilst examining the system after the accident, he found a loose connection on the earthing cable. There was no other fault on the system of earthing. The day after the accident it was found that the insulation of the ammeter coil was punctured. The ammeter was held by three screws, and the bottom screw was half out, whilst the other two were loose. In his opinion the fault on the ammeter was the primary cause of the accident. The defect would show itself by the flashes. If deceased did not unscrew the ammeter somebody else did. He thought it quite possible that deceased went to the ammeter to remedy the flashing. Deceased had attended to minor faults before without cutting off the current, although he had received proper instructions regarding his work.

Robert Nelson, electrical inspector of mines, said he had inspected the scene of the accident, and it was most probable that there was an intermittent fault in the ammeter. He thought it was deceased who loosened the ammeter, and as he was doing so, he got a shock. He found no fault in the construction of the electric plant, and thought the accident was due to excess of zeal on deceased's part.

The jury returned a verdict of "Accidentally killed."

Radiology and Electricity.—It is proposed to hold a Congress of Radiology and Electricity at Brussels next year, in connection with the International Exhibition. The Congress will meet on September 6th, and the meetings will extend over three days. Prof. E. Rutherford will act as president of the British Committee.

Appointments Vacant. — Electrical fitter for the Children's Infirmary at Carshalton (42s.); working electrical mechanic for Brecon and Radnor Asylum (30s. +). See our "Advertisement" pages for particulars.

Cricketers at Dinner.—The fifth Annual Dinner and Concert of the Kensington and Knightsbridge Electric Lighting Co.'s Cricket Club was held on Saturday last, the 20th inst, at the Addison Hall, Addison Road, Holland Park, W., the chair being taken by Mr. R. S. Erskine, and the vice-chair by Mr. H. W. Miller. Songs and selections were given by Misses Gertrude Cooper and Mabel Moyle, and Messrs. Cooper Mitchell, Guy Docwra, S. W. Alcock, E. Driver, F. Mitchell, H. W. White and E. Williams, Mr. Gordon Goodyer presiding at the piano. Mrs. Steuart Erskine presented the club and other prizes to the various prize winners. Toasts were proposed and responded to, and one or two speeches made.

The Farningham Motor-Car Accident.—The charge against Mr. Clifton Robinson of causing the death of some hop-pickers by knocking them down with a motor-car was before the Maidstone Assizes on the 19th inst. No evidence was offered against the defendant; the jury returned a formal verdict of "Not Guilty," and was discharged.

Design of Electromagnets.—A correspondent asks:—"What size and winding of electromagnet should I require to 'draw' a distance of ½ in. and hold a weight of 2 lb.? Would an accumulator be the best method of energising it? if so, what voltage should I require for, say, 20 magnets, all to be actuated by one switch, and would greater or less numbers be in the same ratio?" Perhaps some of our readers will favour him with the desired particulars.

Cures by Electricity. — Under this heading the *Westminster Gazette* states that a new system of electro-therapeutics has been invented by Mr. K. Mueller, of Zurich, who is said to employ the effects of the electromagnetic field upon the body instead of the direct application of electric current. His invention is based upon observation of the superior health of men working in a strong magnetic field at the St. Gothard Tunnel.

The same note refers to an account by Prof. F. Nagelschmidt of the successes already attained in the curing of diseases by the ordinary system of using high-frequency electric currents, the only sensation experienced by the patient being a rise of temperature. This system, is, of course, much used in British hospitals.

Institution and Lecture Notes.—Institution of Electrical Engineers of Chile.—In June last year this Institution was inaugurated; it holds its meetings in the University, Santiago. The programme for this year includes papers on "Continuous-Current Meters," by W. Cordero; "Electrolysis of Nitrate of Soda," by Prof. B. Diaz Ossa; "San Bernardo Electric Tramway," by Horacio Valdes; "The Talca Hydro-Electric Installation," by Prof. Rafael Edwards; "The Electrification of Railways," a report presented by Horacio Valdes; "The Preservation of Wood Poles," by C. A. Smith, A.Am.I.E.E.; "Electric Signals for Railways," by James McKerlie, A.I.E.E. and A.M.I.C.E.; and "Governmental Control of Telegraphs and Telephones," by Luis Norero. The directors of the Institute are anxious to hold intercommunication with the engineering Institutions and Societies of Europe and the United States. The postal address is:—El Secretario, Instituto de Injenieros Electricistas, Universidad Santiago, Chile.

On Friday last, at a meeting of the Barrow and District Association of Engineers, Mr. Wm. Drysdale, A.M.I.E.E., read an interesting paper on "Electrical Energy from a Supply Station." In order to show the effect of the metallic-filament lamps on consumers and supply stations, the lecturer gave figures showing the actual saving effected by some of the Barrow consumers with the new lamps. These varied from 46 per cent. saving in consumption, and 66 per cent. increase in candle-power, to 63 per cent. saving in consumption, and 9 per cent. increased candle-power. At a large business house in Barrow, where the candle-power was 512 with carbon lamps, and the annual account £36 1s 9d. for 1906, at the end of September, 1909, the annual account was £18 7s. for 1,486 C.P., the bulk of the latter consisting of metallic-filament lamps; the gross saving was 49·2 per cent., with an increased candle-power of 190 3 per cent. Allowing £4 10s. for actual renewals for 1909, the net saving came out at £13 4s. 9d., or 36 7 per cent. Mr. H. R. Burnett, borough electrical engineer for Barrow, opening the discussion, gave an example of a building in Barrow, where the carbon lamps were replaced by tantalums, and the annual account was reduced from £150 to £81.

Physical Society of London.—At the meeting held November 12th, 1909, a paper entitled "The Absorption Spectrum of Potassium Vapour" was read by Mr. P. V. Bevan, and one entitled "Some further Notes on the Physiological Principles underlying the Flicker Photometer" was read by Mr. J. S. Dow.

Finsbury Technical College Old Students' Association.—The fourth annual dinner will be held at the Criterion Restaurant, Piccadilly Circus, on December 4th. The hon. sec. for the Electrical Department is Mr. Ernest W. Moss, 20, Huddleston Road, Tufnell Park.

University College, London.—A special advanced Course of Lectures for postgraduate students, telegraph and telephone engineers and electrical engineers on "The Theory of the Propagation of Electric Currents in Telegraph and Telephone Cables and in Electric Conductors" will be delivered by Prof. J. A. Fleming at University College, beginning on January 19th.

Illuminating Engineering Society.—The inaugural meeting of the first session was held on Thursday last week at the Royal Society of Arts, when Prof. S. P. Thompson, president, read his address. The hon. sec., Mr. Leon Gaster, stated that the membership numbered 164.

Institution of Electrical Engineers (Manchester Students).—The opening meeting of the Manchester Students' Section was held on November 9th in the form of a supper and smoking concert. About 150 members and friends were present, and a most enjoyable evening was spent.

Institution of Electrical Engineers (Birmingham).—The third Annual Dinner of this Section was held on November 12th at the Grand Hotel, Birmingham. The Chairman, Mr. R. K. Morcom, presided, and about 100 members were present. Proposing the toast of "The Institution," Mr. Morcom said that in reading Dr. Kapp's presidential address he had noticed the large number of foreign names which it contained. He did not, however, think that this was a sign of the inferiority of British engineers. It was the capitalists and financiers rather than the engineers who needed technical training. There was no denying that at the present time the state of the electrical industry was not all it might be. Prof. Kapp, in responding, said that as a result of 11 years' experience in Germany, he could confidently assert that the statement of our inferiority to them was not just. In his opinion we held the lead in the manufacture of electrical machinery and apparatus, although we lagged behind them in its use and application. Mr. Morcom had attributed this to lack of enterprise, but he was inclined to think that it was largely the result of the newness of the German industries, which had had to struggle into existence against the competition of very powerful rivals. With us the use of modern plant was not so much a necessity as a convenience.

The toast of "The Birmingham Local Section" was proposed by Mr. W. M. Mordey, who made some interesting statements in regard to the progress of the Institution's new home on the Thames Embankment, which they hoped to enter next June, and in which they expected the next inaugural address would be given. The amount of work done in this country, he said, was very great, but it was spread over too many people. On the whole, however, he had proof that the total work was steadily increasing, and, in fact, the electrical industry was not in such a bad way after all. The Institution must resist any temptation to make it into a Trade Protection Society. Their right aim was to keep up a standard of good engineering and honourable conduct.—Mr. Vaudrey, in reply, said that Birmingham as a centre of electrical industry was particularly strong, owing to the number of varied trades which were carried on there. Mr. Chattock's low figures for power supply had enabled him to capture various firms taking large amounts of power.

Mr. Patchell, in a humorous speech, proposed the toast of "The City of Birmingham," and Mr. Chattock replied, remarking that the electricity supply department was giving over 7,000 kw. of high-tension supply to large works in the district.

A capital programme of musical and other entertainments was performed between the speeches, and conduced to a very enjoyable evening.

New Electrical Proposals to come before Parliament.—The last two issues of the *London Gazette* contained copies of an instalment of the applications that are being put forward for electrical and other schemes for consideration in the next Session of Parliament. The list is not yet closed—November 30th is the last date—when it is, we shall give particulars in our customary form.

Electrical Business in Russia.—A correspondent who has had 2½ years' residence in Russia, in the interests of British electrical engineering, writes:—"I have followed with interest your various articles and notes on business in Russia, and may I add that I agree entirely with the views you have expressed."

Inquiries.—Makers of the following are asked for:—Oiless trolley catcher; rimmed gear wheels for tramcar motors; cylindrical graphite electrodes.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—The Radcliffe U.D.C. has increased the salary of Mr. Wilkinson, electrical engineer, from £150 a year to £200.

Mr. E. M. Hayward, shift engineer at Fulham electricity works, having resigned to take up a better appointment at Peterborough, Mr. A. Ardern, junior charge-engineer, who has been at the station for five years, is to be promoted to his position. Mr. Pearson, switchboard attendant, is to take Mr. Ardern's duties, and a new switchboard attendant is to be engaged. The Borough Electrical Engineer explained that he recommended this course owing to the heavy work of the winter being at hand, and to it taking "many weeks before a new shift engineer is able to take up any regular duties, as the plant is entirely new to him."

Mr. H. H. Couzens, engineer and manager of the West Ham electricity undertaking, recommends a list of salary increases in the sub-departments, which amount altogether to £695 per annum. He says that unless adequate remuneration is given there can be no continuity of work, and the department becomes merely a training-ground for the benefit of other electric supply undertakings. It is proposed that amongst the salaries raised the following rises should be given:—Mr. Lloyd Jones, station superintendent, £300 to £350, rising, by annual increments of £25, to £400; Mr. E. Seddon, assistant station superintendent, £3 per week to £190 per annum, rising, by annual increments of £10, to £210; Mr. W. A. Gilbert, mains engineer, £200 to £250, rising to £300 on April 1st, 1910; Mr. W. Whitney, assistant mains engineer, £150 to £175.

Mr. J. Johnson, who has been in the employ of the Heston and Isleworth U.D.C. Electricity Department since its formation, has secured an appointment as chief electrician at Beardmore's Steel Works, Glasgow.

On the 9th inst. at St. George's Church, Rollesley, the marriage took place of Mr. C. E. Gray, engineer to the Ross Electric Light and Power Co., to Eleanor Isobel, eldest daughter of Mrs. Batt and the late E. A. le Fleming Esdor, of Rollesley Hall, Norfolk.

General.—The Royal Society has awarded the Hughes Medal to Dr. R. T. Glazebrook, F.R.S., for his researches on electrical standards.

Mr. A. G. Warren, B.Sc. Eng. Hons., has been appointed assistant in the electrical engineering department of the East London College.

A Glasgow paper says that Mr. William Warren, a veteran of electric telegraphy, is retiring from the general managership of the Eastern Extension Co.'s lines in Australia, which he has held for 20 years. A native of Dorsetshire, he entered the service of the pioneer telegraph company in 1852. He was stationed at Turin, Genoa, and Suez. While he was superintendent at Suez, he had to see after the transmission of the numerous dispatches relating to the Abyssinian War.

On the evening of the 19th inst. in the Gateshead Town Hall, the officials and employés of the Sunbeam Lamp Co., Ltd., held their second annual Whist Drive and Dance, over 200 couples being present. Advantage was taken of the occasion to recognise the long service of the secretary and assistant manager, Mr. T. J. Grainger, who has completed 21 years with the company. Mr. J. W. Edmundson, managing director, presided, and Mr. Robt. Scope, director, addressed the gathering. In his remarks Mr. Scope referred at length to the business capabilities of Mr. Grainger and his high personal character, and said that in the lengthy period completed Mr. Grainger had justly earned the appreciation and esteem expressed. The presentation made on behalf of the officials and office staff by Mr. R. M. Beresford consisted of a framed photograph of the various members, artistically arranged by Messrs. Frank & Sons, Gateshead; and, on behalf of the officials and works' staff, a handsome marble timepiece with forams was handed over by Mr. T. Henderson. Mrs. Grainger was the recipient also of a vanity bag. Mr. Grainger suitably responded. The Whist Drive prizes were presented by Mrs. H. W. Edmundson.

Mr. W. O'Brien, of the Formby (Liverpool) Electrical Power Station, has just been appointed to a position at the L. and Y. Railway Co.'s works at Horwich.

Mr. T. J. West, who has retired, after 44 years' service, from the post of Superintendent of the Electricity Department of the Post Office for the North Midland district, has been succeeded by Mr. A. Longden, Assistant Superintendent Engineer.

Mr. F. Bruckshaw, who is about to take up an important position in Spain, was the recipient of a kit bag, travelling trunk, and a pipe, at the Hightown Hotel, on Monday evening, November 22nd. The presentation was made by Mr. Montgomery, resident electrical engineer, Formby (L. & Y.) power station, on behalf of the staff of the electric traction department.

Mr. J. Stoitner, M.I.E.E., who has had some 30 years of practical electrical engineering experience in England, Germany, and the United States, has opened offices at Birkbeck Bank Chambers, Holborn, London, W.C., where he will carry on business as engineer and contractor. It will be remembered that Mr. Stottner held the position of general manager of the Electrical Co., Ltd., London (A.E.G., Berlin), and the enormous progress which this company made during the 15 years of his management is well known. Among the contracts which he successfully closed during that time may be mentioned:—The Stuart Street generating station and sub-stations, Manchester, with 30,000-h.p. generating capacity; about 4,000 h.p. in generators and motors for the Royal Arsenal, Woolwich; the complete electrification of the Holwell Ironworks; the power station and complete electrical drive at the Kearsley Spinning Mills; the underground equipment of the Lambton Colliery, &c. In all, Mr. Stottner has been responsible for close on £2,000,000 worth of various electrical plant in the United Kingdom alone. Mention may also be made of the fact that he was one of the pioneers of high-tension three-phase power transmission in this country, and that he is fully equipped for dealing with any class of electrical engineering business. Mr. Stottner carries with him our best wishes for continued progress.

An Edinburgh paper says:—"Fully two years ago Mr. John Newlands, Deputy-Controller of Telegraphs at St. Martin's-le-Grand, and formerly Controller of Telegraphs in Edinburgh, was 'lent' to the Indian Telegraph Department for the purpose of reorganising the system of telegraph working in that country. It may be remembered that Mr. Newlands' first efforts in that direction were resented by some members of the staff, and that a partial strike took place. Mr. Newlands proceeded with the work of reform, and the great success which has attended it has now been officially recognised. He has been made a Companion of the Most Eminent Order of the Indian Empire; and in the report of Mr. T. D. Berrington, Director-General of Telegraphs in India, warm testimony is borne to the excellence of the work he has accomplished."

Obituary.—The death occurred on November 22nd, in London, of Baron George de Reuter, second surviving son of the late Baron de Reuter, and a director of Reuter's Telegram Co., Ltd.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Electrical Press, Ltd.—This company's annual return was filed on November 17th, when 4,657 shares had been taken up out of a nominal capital of £5,000 in £1 shares. £1,657 has been paid, and £3,000 is considered as paid. Mortgages and charges: Nil.

Imeson, Finch & Co., Ltd. (97,639).—Debenture dated November 3rd, 1909, to secure £800, charged on the company's undertaking and property, present and future, including uncalled capital. Holders: Hanson, Brown & Co., Ltd., Queen's Square, Middlesbrough.

La Capital (Extensions) Tramways Co., Ltd. (55,966).—A memorandum of satisfaction in full of charge dated February 10th, 1893, securing £120,000, has been filed.

Magneto Co., Ltd.—Debenture dated November 9th, 1909, to secure £3,000, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: J. J. Horne, Maycroft, Stanley Road, King's Heath.

Schreiber Electric Battery Co., Ltd. (96,715).—Debenture dated November 3rd, 1909, to secure £1,000, charged on the company's undertaking and property, present and future, including unpaid capital. Holder: H. P. Schreiber, 31, Southwick Street, Hyde Park.

CITY NOTES.

German Company Dividends.

The *Berliner Tageblatt* states that the year 1908-9 has been a period of advancing development for the electrical undertakings in general. The A.E.G. has increased its dividend from 12 to 13 per cent., the Siemens & Halske Co. will presumably raise its rate from 11 to 12 per cent., and the Bergmann Electricity Co., whose financial period ends with the calendar year, will very probably maintain its rate of 18 per cent. On the other hand, the conditions in the case of the Felten & Guilleaume-Lahmeyer Works appear to be less favourable, as the directors have announced that a further moderate decline in the dividend will have to be reckoned with for the year terminating with December. When the latter company was formed as an amalgamation of the two works indicated by its title, the dividend paid in 1905, which was the first year of the fusion, was 10 per cent. and in 1906 11 per cent.; but in the following year of general prosperity the distribution was reduced to 10 per cent. and to 8 per cent. in 1908, whilst 1909, as already mentioned, is to witness a further moderate decline. The announcement recently made by the directors was to the effect that the business results of the Carlswerk, in Mulheim, have also been satisfactory in 1909, and have not been inferior to 1908, but that those of the Frankfort department have been less satisfactory, and will unfavourably affect the total results for the year. Prof. Salomon, chief manager of the Frankfort Works, is retiring from the position. A correspondent of the Berlin newspaper points out that the company, in addition to the construction of machinery over many years, has embarked upon fresh branches by the establishment of an arc lamp factory, an apparatus factory, measuring instrument factory, and a glow lamp factory, and even on the construction of motor-cars. All these special departments cost money, but this would not have been so bad if other large, medium and small works had not for years past been able to supply the articles cheaply. The Frankfort works began where others had finished years ago with studies and trials, the experience has had to be paid for, and these are the principal causes for the diminution of the financial results. The correspondent adds that just as little is understood in the Mulheim Carlswerk about manufacturing in the Frankfort department as is understood in the latter about the manufacture of cables and wire ropes. In addition to this the Berlin newspaper submits that there must not be left out of consideration the circumstance that the period of depression has not passed over the electrical industry without leaving traces. The sale prices of many articles have considerably declined, and have, in fact, not yet materially improved. Orders have largely been accepted by individual companies, often at any price, owing to keen competition, and the system of subsidiary companies and interests, which afford a stock of work to the parent undertakings, is less developed in the Felten and Guilleaume-Lahmeyer works than in the case of two other companies.

Paris Compressed Air Co.

The increase in the receipts of the Compagnie Parisienne de l'Air Comprimé from the supply of electricity in 1908-9, was relatively small, as the company was only entitled to claim on the basis of the supply furnished in 1905, whilst the remainder belongs to the Association of Sectors or amalgamated supply works, and serves to compensate those Sectors whose concessions have been curtailed. The financial position is as follows for the past two years:—

	1908-9.	1907-8.
Share capital	£1,000,000	£1,000 000
Electricity receipts	264,400	263,100
Compressed air receipts	104 400	102,800
Net profits	102,800	101,600
Dividend on ordinary shares in francs ...	34 89	34·78
Dividend on preference shares in francs	26·59	25·96

The company's report states that the supply of compressed air for lifts experienced a further expansion, but that for clocks and power purposes again decreased. On June 30th, 1909, the company possessed 24,310 shares in the Compagnie Parisienne de Distribution d'Electricité, and a further block of 24,341 shares was taken over on the increase of the latter's capital. The large number of shares which a German group held in the Compressed Air Co. have, with the exception of 12,000 retained by a Cologne firm, been repurchased by a French banking syndicate at the price of 145 per cent.

Official Announcements re Companies.—The following companies will be struck off the register in three months, unless cause is shown to the contrary:—

Acoustic Patents (France), Ltd.
Anglo-Brazilian Rubber Syndicate, Ltd.
Beeston Accumulator Syndicate, Ltd.
Birmingham Electrobus Co., Ltd.
Dorchester Electric Light & Power Co., Ltd.
Electric Canal Haulage Co., Ltd.
Electric Mercantile Agency, Ltd.
International Telegraphic Appliances, Ltd.
Lancashire & Yorkshire Electrobus Co., Ltd.
Liverpool Electrobus Co., Ltd.
Malabar Rubber Plantations, Ltd.
Manchester Electrobus Co., Ltd.
Nottingham Electrobus Co., Ltd.
Nottingham Gas & Electric Fittings Co., Ltd.
Provincial Electrobus Co., Ltd.
Richardson Electrical Co., Ltd.
Rubber Syndicate, Ltd.
Scottish Electrobus Co., Ltd.
Tramways Development Co., Ltd.

Dorman, Long & Co., Ltd.—For the year ended September 30th there was a profit of £103,173. A final dividend of 2 per cent. for the year is to be paid. There is written off for depreciation £30,000, and £54,699 is carried forward. Included in the capital expenditure for the year (£71,623), was the final payment for the electrically driven mill.

Mather & Platt, Ltd.—The capitalisation and distribution of a portion of the reserve fund of undivided profits has been recommended by the board. According to the *Times* they propose to divide £200,000 of the reserve as a bonus, and to satisfy such bonus by the allotment of 200,000 fully-paid ordinary shares of £1 each. "These, subject to the rights of the holders of the existing preference shares, will confer the right to dividend computed from January 1st, 1909, and will be issued to the holders of ordinary shares in the proportion of five shares of £1 each in respect of each ordinary share of £10. It is also proposed for the sake of convenience to sub-divide the existing ordinary shares of £10 each into 400,000 shares of £1 each."

Montreal Street Railway Co.—According to a financial daily, the net income for the past year amounted to $1,229,700. A dividend of 10 per cent. has been paid.

Adelaide Electric Supply Co., Ltd.—A dividend at the rate of 6 per cent. per annum is recommended on the ordinary shares for the year ended August last.

Prospectuses.—*Aengsono (Java) Rubber Plantations, Ltd.*—This company is offering for subscription 22,500 shares of £1 each. It has 324 acres planted with rubber and coffee, and during the next two years the planted acreage will be increased to 1,024.

Amazon Telegraph Co., Ltd.—This company is offering for subscription (the list closes on Monday, November 29th) an issue of £300,000 5 per cent. debentures at the price of 98 per cent. The proceeds will be applied to redeeming the whole of the 6 per cent. and 5 per cent. debentures now outstanding, and to providing for the cost of the duplication of the cable, which was referred to at the recent annual meeting of the company (see Electrical Review, November 19th).

Mackay Companies.—The directors have declared a quarterly dividend of 1¼ per cent. on the Common shares.

France.—The report of the Société des Trefileries du Havre for the last financial year shows a net profit of only £37,712, as compared with £108,338 in the preceding 12 months. The dividend is, however, being maintained at 10 fr. per share.

La Société Centrale d'Industrie Electrique is the name of a new company, which has just been formed in Paris, with a capital of £200,000. The Thomson-Houston Co. and the Gesellschaft für Electrische Unternehmungen, of Berlin, are interested in the new undertaking.

MARKET QUOTATIONS.

Wednesday, November 24th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a " Nitric	"	22/-	..
a " Oxalic	"	28/-	..
a " Sulphuric	"	5/6	..
a Ammoniac, Sal	"	42/-	..
a Ammonia, Muriate (crystal) ..	per ton	£29	..
a " "	"	£30	..
a Bleaching powder	"	£5 10	..
a Bisulphide of Carbon	"	£18	..
a Borax	"	£16	..
a Ferro-Silicon (50 %)	"	£11	..
a Copper Sulphate	"	£18 10	..
a Lead, Nitrate	"	£26 10	..
a " White Sugar	"	£23 10	..
a " Peroxide	"	£32	..
a Methylated Spirit	per gal.	2/6	..
a Potassium, Bichromate, in casks	per lb.	8½d.	..
a Potash, Caustic (75/80 %) ..	per ton	£20	..
a " Chlorate	per lb.	8½d.	..
a " Perchlorate	"	8½d.	..
a Potassium, Cyanide	"	7d.	..
a Shellac	per cwt.	75/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers ..	"	£6 10	..
a " Recovered	"	£5 10	..
a " Lump	"	£5	..
a Soda, Caustic (white 70 %) ..	"	£11	..
a " Chlorate	per lb.	8½d.	..
a " Crystals	per ton	£3 5	..
a Sodium Bichromate, casks ..	per lb.	8d.	..
a " Cyanide (basis 100 %) ..	"	7d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots ..	per ton	£75	..
b " Wire, in ton lots ..	"	£112	..
b " Sheet, in ton lots ..	"	£120	..
p Babbitt's metal ingots	"	..	..
c Brass (rolled metal 2" to 12" basis)	per lb.	7¾d.	¼d. inc.
c " Tube (brazed)	"	9d.	¼d. inc.
c " " (solid drawn) ..	"	7¾d.	¼d. inc.
c " Wire, basis	"	6¾d.	¼d. inc.
c Copper Tubes (brazed)	"	9d.	¼d. inc.
c " " (solid drawn	"	9d.	¼d. inc.
e " Bars (best selected) ..	per ton	£74	£2 inc.
e " Sheet	"	£74	£2 inc.
e " Rod	"	£74	£2 inc.
e " (Electrolytic) Bars ..	"	£62 15	£2 5 inc.
e " " Sheets ..	"	£79 5	£2 5 inc.
e " " Rod	"	£67 15	£2 5 inc.
e " " H.C. Wire	per lb.	8¾d.	¼d. inc.
f Ebonite Rod	"	3/8	..
f " Sheet	"	3/-	..
n German Silver Wire	"	1/6	..
h Gutta-percha, fine	"	5/6 to 6/6	..
h India-rubber, Para fine	"	8/2½	¼d. dec.
l Iron Pig (Cleveland warrants) ..	per ton	51/-	2d. inc.
l " Wire, galv. No. 8, P.O. qual.	"	£14	..
g Lead, English Ingot	"	£13 7 6 to £13 10	2/6 inc
m Manganin Wire No. 28	per lb.	6/6	..
c Mercury	per bot.	£9 17 6	..
d Mica (in original cases) small ..	per lb.	6d. to 1s.	..
d " " " medium	"	2/6 to 4/-	..
d " " " large ..	"	4/6 to 8/6	..
p Phosphor Bronze, plain castings	"	..	..
p " " rolled bars & rods	"	..	..
p " " rolled strip & sheet	"	..	..
o Platinum	per oz.	120/-	variable.
e Silicium Bronze Wire	per lb.	9d.	..
r Steel Magnet, in bars	per ton	£55	..
g Tin, Block (English)	"	£137 10 to £138 10	£1 10 inc.
n " Wire, Nos. 1 to 16	per lb.	1/9½	¼d. inc.
p White Anti-friction Metals:—			
"White Ant" brand	per ton	..	..
k Zinc, Sh't (Vieille Montagne bnd.)	"	£27	..

Quotations supplied by—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
l Bolling & Lowe.
k Morris Ashby, Ltd.
l Richard Johnson & Nephew, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Co., Ltd.
r W. F. Dennis & Co.

Reduction of Capital.—Raworth's Traction Patents, Ltd., and Reduced.—A petition for confirmation of the reduction of the capital of this company from £30,000 to £20,625 is to be heard on December 7th.

Liquidation.—Baker Oil Separator Co., Ltd.—This company is winding up voluntarily, with Mr. W. E. Frank as liquidator.

Douglas Southern Electric Tramways, Ltd.—The directors report that the season consisted of 125 days, against 115 days last year. The total receipts were £4,790; the net profit for the year was £1,522. The dividend of 5 per cent. upon the preference shares absorbs £1,298, and £303 is carried forward.

Metropolitan Amalgamated Railway Carriage and Wagon Co., Ltd.—The directors have declared a dividend for the half-year ended September 30th last on the ordinary shares at the rate of 7½ per cent. per annum, free of income-tax.

STOCKS AND SHARES.

Tuesday Afternoon.

Mining shares, apart from those in copper companies, have fallen so heavily during the end November settlement that other departments feel the strain involved by the necessity for realising investment securities in order to meet speculative losses. With the money market in its present ungenial condition, and with political uncertainty occupying men's minds, there is little or no assistance for the Stock Exchange, where the slump in Kaffirs, with its resultant rally, is the outstanding feature for the time being. Our tale this week must perforce be tuned to the minor, although some satisfaction is to be recorded that, after all, the critical conditions prevalent elsewhere have affected electrical issues perhaps less than might have been expected.

The amalgamation of interests between the Baker Street and Waterloo, Piccadilly & Brompton, and Charing Cross & Euston tube railways has led to no changes in the quotations of the 4 per cent. Debenture stocks of the three concerns. Bakerloo Debenture is 98 and the other two 96. The interest on the former is payable January 14th and July 14th, while on the others it falls due on January 1st and July 1st. Therefore the three prices carry five months' interest, equal to about 1⅔ per cent.

Underground stocks are weak. Central London Preferred and City and South London Ordinary stocks are down a point apiece, and the older Undergrounds have moved down. Districts fell ¼ to 15⅜, despite the notice given of a Bill to deal with the interest arrears. The company's 6 per cent. Debenture stock changed hands at 140 on Monday, while the Extension Preference was done at 48 on the same day. The other Preference stock, upon which the 3½ per cent. interest is guaranteed by the Underground Electric Railways of London, stands at 67. The Underground Electric Company's trio of issues are without quotable change.

By a curious coincidence it happened, a few days after our references to radiators, that some of the London companies started a vigorous campaign of advertising and pushing these little devices, as it was suggested here that it might pay them to do. With the snap of cold weather to underline the appeal, the companies ought to be doing well; but perhaps still more could be accomplished by the aid of further personal service and calling upon the users of the current for lighting purposes.

Charing Cross Ordinary are up ¼, and the Preference down by the same fraction, which amount has also been taken from County of London Ordinary, Edmundson's Preference and London Electric Preference. Rather an unusual feature in this department is provided by a rise of ⅕, to 20s., in Smithfield Ordinary shares, upon attention being called to the improved condition into which the company has been gradually working. River Plate Electric Ordinary drooped, and Victoria Falls Power Preference slipped back to 18s. because of the slump in Chartered and other South African shares. The company's 5 per cent. "A" Debenture stock is par to 102.

The Canadian-Mexican group of light and power companies has withstood the prevailing weak tendency with marked success. Rio Trams at 95 are 5 up, Sao Paulo at 154½ are 2 better, and Mexico Trams gained ½. British Columbia Electric Deferred continues to ease off. British Electric Tractions are steady. Anglo-Argentine Trams 5 per cent. First Preference receded slightly. United of Monte Video Preference rose to 5½, which is the same price as the Ordinary, and the 5 per cent. First Debenture stock is about 102. London United Tramways 4 per cent. Debenture stock at 67½ is a point lower.

Telegraph descriptions are very undistinguished. The Anglo-American division has been flat. West India and Panama Ordinary have shaded off, although the Preference shares retain their rises. Great Northern Telegraphs improved a small fraction. Amazon Telegraphs are ½ better, and the 5 per cent. Debentures did not move on the appearance of a prospectus offering £300,000 5 per cent. Debentures at 98.

American Telephone and Telegraph rose 2, and so did Mackay Companies' Common, on the reports about a fusion of telephone interests in the United States, although it is said that the Mackay Companies will not be included in the arrangements.

Manufacturing shares are somewhat irregular. Castner-Kellners have responded, with a rise, to the good dividend and report. Babcock & Wilcox lost another ⅞ of their recent advance. Callender's Ordinary and Preference and Henley's Ordinary are both lower, on sales, it is said, necessitated by losses in other markets by speculators who held these as investments. Edison & Swan issues are distinctly flat, the First Debenture shedding 3 points. Telegraph Construction 4 per cent. Debenture has regained its small fall.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. *	Dividends for the last four years. 1906.	1906.	1907.	1908.	Closing Quotations Nov. 16th.	Closing Quotations Nov. 23rd.	Business done week ended Nov. 23rd, 1909. Highest	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	Nil	3 — 3½	3½ — ¼	72/6	67/6	+ ½	Nil.
136,700	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	5 %	5 %	5 %	5 %	99 —102	99 —102	..	..	..	4 18 0
$121,551,400	American Telephone & Telegraph, Cap. Stock ..	$100	7½%	8 %	8 %	8 %	144 —146	146 —148	147½	147	+2	5 8 1
$53,000,000	Do. Collat. Trust, 4% Bonds, 1 to 28,000 and 53,001 to 78,000	$1000	4 %	4 %	4 %	4 %	96 — 98	96 — 98	..	..	..	4 1 8
558,460	Anglo-American Telegraph	Stock	3½%	3½%	3½%	£3 4s.	61 — 63	60 — 63	61	..	— ½	5 8 2
3,220,770	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	6 %	101½—102½	101 —102	102	101	— ½	5 17 8
3,220,770	Do. do. Deferred	Stock	½%	1½%	1 %	8/-	22⅝— 23⅝	21⅞— 22½	22⅛	22	— ⅜	1 16 2
47,725	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	5 %	5 %	5 %	5 %	101 —108	101 —108	..	..	..	4 17 1
44,000	Chili Telephone, Nos. 1 to 44,000	5	8 %	8 %	8 %	8 %	7⅞— 8⅛	7⅞— 8⅛	..	..	..	4 18 6
2,481,350	Commercial Cable, Sling. 600 year 4% Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	87½— 89½	87⅞— 89½	89	88½	..	4 9 5
16,000	Cuba Telegraph	10	5 %	5 %	6 %	6 %	8⅝— 9⅛	8⅝— 9⅛	..	..	..	5 9 9
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	10 %	17 — 18	17 — 18	..	..	..	5 11 1
12,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3 — 3½	3 — 3½	..	..	..	5 14 8
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	8 — 8½	8 — 8½	..	..	..	6 5 0
80,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	100½—102½	100¼—102½	..	..	..	2 3 11
80,710	Direct United States Cable	20	4½%	4½%	4½%	4½%	13 — 13½	13 — 13½	..	..	..	6 4 7
43,500	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 3
4,000,000	Eastern Telegraph, Ord. Stock..	Stock	7 %	7 %	7 %	7 %	126½—129½	126½—129½	128¼	127½	..	5 9 1
2,000,000	Do. 8½ % Pref. Stock..	100	8½%	8½%	8½%	8½%	83½ — 85½	84 — 86	85½	84½	+ ½	4 1 5
1,996,706	Do. 4 % Mort. Deb. Stock. Red. ..	Stock	4 %	4 %	4 %	4 %	102 —104	102 —104	103	102	..	3 16 11
800,000	Eastern Extension, Australasia, and China Tele	10	7 %	7 %	7 %	7 %	11¾— 12½	11¾— 12½	12⅜	11¾	..	5 14 8
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	102 —104	103 —104	103½	102¾	..	3 16 11
200,000	East. & S. Afric. Tel., 4 % Mt Db. Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..	3 18 6
181,127	Globe Telegraph and Trust	10	5½%	5½%	5½%	5½%	10½— 10⅝	10½— 10⅝	10⅝	10⅝	..	5 8 3
181,127	Do. do. 6 % Pref...	10	6 %	6 %	6 %	6 %	13½— 14	13½— 14	13⅝	..	..	4 5 9
150,000	Great Northern Telegraph, of Copenhagen.. ..	10	24%	20 %	20 %	18 %	28½— 29½	28½— 29½	..	..	+ ½	6 5 8
10,000	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 8
17,000	Indo-European Telegraph	25	18 %	18 %	18 %	18 %	51 — 53	51 — 53	52	..	..	7 1 9
$41,380,400	Mackay Companies Common	$100	2 %	3½%	4 %	4 %	93 — 95	96 — 98	..	..	+3	4 1 8
$60,000,000	Do. do. 4% Cum. Pref.	$100	4 %	4 %	4 %	4 %	77 — 79	77 — 79	..	..	..	5 1 3
894,190	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	Nil	⅜— ⅜	⅜— ⅜	..	..	..	Nil
79,680	Monte Video Telephone Co., Ltd. Ord. ..	1	5 %	6 %	6 %	6 %	⅜— ⅜	⅜— ⅜	..	..	..	6 8
96,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	5 %	⅜— ⅜	⅜— ⅜	..	..	..	5 6 8
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	107 —108½	107 —108½	107⅝	107½	..	5 10 7
3,725,000	Do. do. Def. Stock	100	5 %	5 %	6 %	6 %	120 —122	120 —122	121½	120¾	..	4 18 9
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	10½— 11	10½— 11	..	..	..	5 9 1
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	10½— 10⅝	10½— 10⅝	..	..	..	5 10 4
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5⅛— 5⅜	5⅛— 5⅜	..	..	..	4 8 11
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	98 —100	98 —100	..	..	..	3 10 0
1,983,698	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	100 —102	100 —102	100½	..	..	3 18 6
179,818	Oriental Telep. and Elec. 1 to 171,504, fully paid ..	1	7 %	7 %	8 %	8 %	1⅜— 1⅛	1⅜— 1⅛	27/6	..	..	5 5 9
50,000	Do. do. do. 6 % Cum. Pref... ..	1	6 %	6 %	6 %	6 %	1⅛— 1⅛	1⅛— 1⅛	..	..	..	4 14 9
99,100	Do. do. do. 4 % Red. Deb. Stock ..	100	4 %	4 %	4 %	4 %	88½— 89½	87 — 89	87½	..	+ ½	4 9 11
99,400	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	10	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..	3 18 5
11,889	Reuter's	8	5 %	5 %	5 %	5 %	7⅞— 8⅛	7⅞— 8⅛	..	..	..	4 18 9
145,955	Telephone Co. of Egypt, 4½ % Deb. Red. ..	100	4½%	4½%	4½%	4½%	100½—102½	100½—102½	..	..	..	4 7 10
3,042	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	129 —132	129 —132	..	..	..	4 10 11
120,000	United River Plate Telephone	5	8 %	8 %	8 %	8 %	6½— 7⅛	6½— 7⅛	7⅛	7⅛	..	5 10 1
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5⅞— 6⅛	5⅞— 6⅛	..	..	..	4 8 4
80,008	W. Coast of America, 1 to 80,000 & 53,001 to 53,008	2½	Nil	2½%	2½%	2½%	1⅝— 1¾	1⅝— 1¾	..	..	..	3 16 4
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..	3 18 5
307,380	Western Telegraph, Ltd., Nos. 1 to 307,380.. ..	10	7 %	7 %	7 %	7 %	13½— 13⅝	13½— 13⅝	13⅛	13⅜	..	5 1 10
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	103 —105	103 —105	..	..	..	3 16 2
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	Nil	⅜— ⅝	⅛— ⅜	16/-	15/8	— ⅛	Nil
84,568	Do. do. 6 % Cum. 1st Pref.	10	6 %	8 %	6 %	6 %	9 — 9½	9 — 9½	..	..	..	6 6 4
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	£2 6	12 %	9 — 10	9 — 10	..	..	..	15 0 0
80,000	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	102 —104	102 —104	..	..	..	4 16 2

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

640,000	Anglo-Argentine Trams, 5 % Cum. 1st Pref., 1 to 640,000	5	..	..	..	..	4½— 4¾	4⅞— 4¹⁵⁄₁₆	93/9	88/9	— ⅜	5 2 4
500,000	Do. 5 % 2nd Pref., 800,001 to 1,300,000	5	..	..	..	..	4¼— 4⅜	4¼— 4⅜	..	..	..	5 11 1
978,280	Do. 4 % Deb. Stock	..	..	..	..	4 %	90½—92	90 — 91½	91½	91	— ½	4 7 5
882,887	Auckland E. Trams, 5 % 1st Mort. Deb. Stock ..	100	5 %	5 %	5 %	5 %	102 —105	102 —105	..	..	..	4 15 3
580,000	Babcock & Wilcox, 1 to 580,000..	1	20 %	20 %	20 %	20 %	4⅞— 4¹⅛	4⅞— 4¹⅛	94/1½	91/8	— ⅛	4 4 3
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	6 %	1⅞— 1¹⁵⁄₁₆	1⅞— 1¹⁵⁄₁₆	..	..	..	3 19 2
60,000	British Aluminium, Ord., 1 to 40,000	5	7 %	7 %	7 %	7 %	2— 1½	2— 1½	..	..	..	37 6 8
60,000	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	1⅞— 2⅛	1⅞— 2⅛	..	..	..	15 1 4
40,100	Do. do. "A" 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	3⅜— 3⅝	3⅜— 3⅝	..	..	..	7 10 11
12,897	Do. do. 4 % Funding Certs.	5	4 %	4 %	4 %	4 %	2⅜— 3⅛	2⅜— 3⅛	..	..	..	5 14 3
124,460	Do. do. 5½ % Loch Leven Debs. ..	100	..	5½%	5½%	5½%	96 — 99	96 — 99	..	..	..	5 14 7
500,000	British Columbia E. Rail Def. Ord. Stock	100	6 %	6 %	8 %	8 %	145 —150	144 —149	146½	146	—1	5 7 5
400,000	Do. Pref. Ord. Stock	100	5 %	5 %	5 %	6 %	121 —125	121 —125	123	122	..	4 16 0
400,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	5 %	107 —110	107 —110	..	..	..	4 10 11
238,000	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	4½%	4½%	4½%	4½%	102 —104	102 —104	..	..	..	4 6 7
212,600	Do. 4½ % Vancouver Power Debs., 1 to 2,300	100	4½%	4½%	4½%	4½%	102½—104½	102 —105	104½	103½	..	4 6 2
186,301	British Electric Traction	10	8 %	Nil	Nil	Nil	⅜— 1	⅜— 1	15/-	..	..	Nil
161,487	Do. do. 6 % Cum. Pref.	10	6 %	6 %	3 %	1¾%	2½— 2⅞	2½— 2⅞	53/1½	..	..	5 6 8
1,473,653	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	84 — 87	84 — 87	86½	84½	..	5 14 11
528,986	Do. do. 4½ % 2nd Deb. Stock Red.	100	4½%	4½%	4½%	4½%	58 — 62	58 — 62	..	..	..	7 5 2
100,000	British Insulated and Helsby Cables	5	8 %	10 %	10 %	10 %	7 — 7⅛	7 — 7⅛	7⅛	..	..	6 13 4
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	6⅛— 6⅜	6⅛— 6⅜	6⅜	..	..	4 11 3
500,000	Do. do. 4½ % 1st Mort. Deb. Red...	100	4½%	4½%	4½%	4½%	103 —106	103 —106	..	..	..	4 4 11
304,940	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	4½%	4½%	4½%	4½%	89 — 94	89 — 94	..	..	..	4 15 9
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	Nil	Nil	Nil	Nil	⅜— ⅝	⅜— ⅝	..	..	..	Nil
1,016,858	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	48 — 52	48 — 52	49½	48½	..	7 13 10
50,000	Browett, Lindley & Co., Ord.	1	Nil	Nil	Nil	Nil	⅝— ¹¹⁄₁₆	⅝— ¹¹⁄₁₆	..	..	..	Nil
50,000	Do. do. 6 % Cum. Pref.	1	Nil	Nil	Nil	Nil	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
140,976	Brush Electrical Engineering, Ord., 1 to 105,781 ..	2	2½%	Nil	Nil	Nil	0 — ¼	0 — ¼	..	..	..	Nil
200,000	Do. do. Non-cum. 6 % Pref.	2	6 %	Nil	Nil	Nil	0 — ¼	0 — ¼	..	..	..	Nil
125,000	Do. do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	41 — 46	41 — 46	..	..	..	9 15 8
125,000	Do. do. 4½ % Perp. 2nd Deb. Stock..	Stock	4½%	4½%	4½%	4½%	27 — 31	27 — 31	..	..	..	14 10 2
187,610	Calcutta Trams, 1 to 187,610	5	8 %	8 %	6 %	4½%	4½— 5	4½— 5	..	..	..	4 10 0
45,804	Do. 5 % Cum. Pref., Nos. 1 to 29,880..	5	5 %	5 %	5 %	5 %	4½— 5	4½— 5	..	..	..	5 0 0
350,000	Do. 4½ % 1st Deb. Stock..	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
85,000	Callender's Cable Construction shares	5	15 %	15 %	15 %	15 %	10½— 10⅝	10 — 10⅜	10⅜	10	— ⅛	6 19 4
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅜— 5⅝	5⅛— 5⅜	..	..	— ⅛	4 8 11
300,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	105 —107	105 —107	..	..	..	4 4 1
491,223	Cape E. Trams., 1 to 491,223	1	Nil	Nil	Nil	Nil	⅞— ⅞	⅞— ⅞	..	..	..	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	6 %	8 %	12 %	12½%	2⅛— 2¼	2⅛— 2¹⁵⁄₁₆	45/-	44/9	+ ⅛	5 12 3
710,158	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4½%	4 %	106 —109	106 —109	107	106½	..	3 13 5
1,890,690	Central London Railway, Ord. Stock	Stock	4 %	4 %	3 %	3½%	61 — 63	61 — 63	62	..	..	5 3 2
554,655	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	85 — 87	84 — 86	84½	..	—1	4 13 0
554,655	Do. do. Def. do.	Stock	4 %	4 %	2 %	2½%	44 — 46	44 — 46	43	..	..	5 8 8
1,480,000	City and South London Railway	Stock	17½	24½	29½	14½	30½— 31½	29½— 30½	30½	29½	..	4 15 3
85,000	Crompton & Co., Nos. 1 to 85,000	5	5½%	5 %	5 %	5 %	½— 1	½— 1	..	..	..	15 1 8
100,000	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	90 — 98	90 — 98	..	..	..	5 7 6

* Unless otherwise stated, all shares are fully paid. † A period of nine months. From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—*(Continued)*

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years.				Closing Quotations Nov. 16th.	Closing Quotations Nov. 23rd.	Business done week ended Nov. 23rd, 1909.		Rise + or Fall −	Present Yield per cent.
		*	1905.	1906.	1907.	1908.			Highest.	Lowest.		£ s. d.
260,000	Dick, Kerr & Co., 1 to 260,000	1	10 %	10 %	10 %	10 %	1 — 1⅛	1 — 1⅛	..	..	..	8 17 9
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	6 %	6 %	6 %	6 %	1 — 1⅛	1 — 1⅛	21/3	..	..	5 6 8
271,080	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
60,000	Dublin United Trams. (1896), 6 % Pref., 1 to 60,000	10	6 %	6 %	6 %	6 %	12⅝ — 13⅜	12⅝ — 13⅜	..	..	..	4 7 8
99,961	Edison & Swan Utd., "A" shs., £3 pd., 1 to 99,961	5	4⅜%	4⅜%	2½%	1¾%	⅜ — ⅝	⅜ — ⅝	..	..	..	34 5 8
17,189	Do. "A" shares, 01—017,189	5	4⅜%	4⅜%	2½%	2½%	1 — 1⅛	1 — 1⅛	22/6	21/9	..	8 6 8
207,895	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	68 — 73	66 — 71	68	..	−1½	5 12 1
67,720	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	89 — 85	81 — 84	..	..	−1	5 19 1
112,100	Electric Construction, 1 to 112,100	2	Nil	Nil	Nil	Nil	⅜ — ⅝	⅜ — ⅝	..	..	..	Nil
31,890	Do. do. 7 % Cum. Pref., 1 to 31,890	2	7 %	7 %	7 %	7 %	1⅛ — 1⅜	1⅛ — 1⅜	23/9	22/6	..	10 4 0
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	5 %	8 — 8½	8 — 8½	..	..	..	5 17 8
200,000	Do. do 4 % Mort Deb.	Stock	4 %	4 %	4 %	4 %	83 — 87	83 — 87	..	..	..	4 12 0
78,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000	10	4 %	4 %	¾%	Nil	¾ — 1	¾ — 1	..	..	..	6 13 4
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	7 %	..	10½ — 10⅝	10½ — 10⅝	..	..	..	6 10 8
80,000	Do. do. 5 % Mort. Debs.	10	5 %	5 %	5 %	5 %	102 —103½	102 —103	..	..	..	4 16 10
40,000	Henley's (W. T.), Telegraph Works, Ord.	5	15%	15 %	15%	15 %	12½ — 13½	12 — 12⅝	12⅝	12½	— ½	5 17 8
40,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5⅛ — 5⅜	.. ..	..	..	..	4 1 10
150,000	Do. do. 4½ % Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	106 —108	106 —108	..	..	..	4 3 4
60,000	India-Rubber, Gutta-percha & Telegraph Works.	10	10%	10 %	10 %	10 %	15⅝ — 16½	15⅝ — 16½	15⅝	..	..	6 1 3
37,500	†Liverpool Overhead Railway, Ord.	10	Nil	Nil	¾%	Nil	⅜ — ⅝	⅜ — ⅝	..	..	..	Nil
10,000	† Do. do. Pref., fully paid	10	5 %	5 %	5 %	5 %	4½ — 5	4½ — 5	..	..	..	10 0 0
800,070	London United Trams. (1901), 1 to 50,007	10	3 %	3 %	3 %	Nil	1½ — 2⅜	1½ — 2⅜	..	..	..	Nil
899,980	Do. do. 60,008 to 100,000	10	3 %	3 %	3 %	Nil	1½ — 2⅜	1½ — 2⅜	..	..	..	Nil
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	5 %	3⅜%	2⅜ — 2⅝	2⅜ — 2⅝	..	..	..	13 0 10
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	67 — 70	66 — 69	..	..	−1	5 15 11
5,732,062	Metropolitan Consolidated	100	2⅜%	1 ⅝%	⅝%	⅝%	36⅞ — 37½	36⅞ — 36⅞	36⅞	36⅜	— ½	2 14 5
2,640,914	Do. Surplus Lands	100	2⅜%	2⅜%	2⅜%	2⅜%	64 — 66	64 — 66	65⅛	64⅛	..	4 3 4
3,285,000	Do. District	100	Nil	Nil	Nil	Nil	16⅜ — 16½	15⅞ — 16	16 1/16	15 15/16	..	Nil
891,387	Metropolitan Electric Trams., Ord.	1	..	..	..	43%	⅛ — ⅛	⅛ — ⅛	..	..	..	6 10 11
814,016	Do. do. Defd.	1	Nil	Nil	Nil	Nil	1/16 — 1/16	1/16 — 1/16	..	..	..	Nil
500,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	⅛ — ⅜	⅛ — ⅜	..	..	..	6 8 1
595,600	Do. do 4½ % Deb. Stock Red.	100	4½%	4½%	4½%	4½%	93 — 96	93 — 96	..	..	..	4 13 9
10,823,200	Mexico Trams Co., Common Stock	..	..	..	..	..	124⅛ —127⅛	125 —128	127½	125⅛	+ ⅜	..
$9,000,000	Do. 1st Mort. 50-year 5% Gld. Bds.	..	..	..	..	5 %	91 — 93	91 — 93	91⅛	91	..	5 7 6
245,500	Potteries Electric Traction	1	4 %	4 %	4 %	Nil	⅛ — ⅜	⅛ — ⅜	..	..	..	..
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	⅛ — ⅜	⅛ — ⅜	..	..	..	6 17 11
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	84 — 87	84 — 87	..	..	..	5 3 6
87,350	Telegraph Construction and Maintenance	12	15 %	15 %	17½%	15 %	34½ — 36	34½ — 36	34⅜	34½	..	5 0 0
140,000	Do. 4 % Deb. Bds., 1 to 1,500 Red., 1909	100	4 %	4 %	4 %	4 %	100½ —102½	101 —103	..	..	..	3 18 1
1,000,000	Underground Electric Railway, 5% Prior Lien	..	..	..	..	5 %	100 —101	100 —101	100⅜	100⅜	..	4 19 0
2,800,000	Do. do. 4½% Bonds	..	..	..	..	4½%	86 — 88	86 — 88	87½	87½	..	5 2 3
4,900,000	Do. do. 6% Income Bonds	..	..	..	..	..	31 — 33	31 — 33	32¼	31½	..	..
66,666	Willans & Robinson, 1 to 80,000 & 80,001 to 116,666	5	Nil	Nil	10 %	Nil	⅛ — ⅜	⅜ — ⅝	..	..	..	..
66,666	Do. 6 % C.P., 80,001 to 80,000 & 125,001 to 141,666	1	Nil	..	6 %	6 %	1⅜ — 2⅛	2 — 2⅛	..	..	..	2 8 4
245,495	Do. % 1st Mort. Deb. Stock		4 %	4 %	4 %	4 %	74 — 79	74 — 79	..	..	..	5 1 3

ELECTRICITY SUPPLY COMPANIES.

15,000	Bromley (Kent) E.L. & P., 1 to 15,000		5⅛%	5⅛%	5⅛%	5⅛%	4⅜— 4⅝	4⅜— 4⅝	..	..	..	5 2 1
70,000	Do. do. 4½ % 1st. deb. stock	100	4½%	4½%	4½%	4½%	91 — 94	91 — 94	..	..	..	4 18 9
80,449	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10 %	10%	10 %	10 %	6½ — 7⅛	6½ — 7⅛	7⅜	..	..	6 13 4
9,551	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	6⅝ — 7⅛	6⅝ — 7⅛	..	..	..	4 13 4
311,876	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	97 —100	97 —100	..	..	..	3 18 5
83,000	Charing Cross and Strand Electricity Supply	5	5 %	5 %	5 %	5 %	3½ — 4	3⅜ — 4⅛	80/-	..	+ ½	6 1 3
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	4⅜ — 4⅞	4¼ — 4¼	..	..	— ⅛	4 14 9
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	3¾ — 4¼	3⅞ — 4⅛	80/-	..	..	5 5 11
445,736	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	98 —101	98 —101	..	..	..	3 19 3
49,436	Chelsea Electricity Supply, Ord.	5	6 %	4½%	4½%	4½%	3⅜ — 3⅞	3⅜ — 3⅞	..	..	..	5 16 2
175,000	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	100 —103	100 —103	101	..	..	4 7 5
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	6 %	6 %	6 %	6 %	10 — 10½	10 — 10½	10 5/16	..	..	5 14 8
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	11⅜ — 12⅜	11⅜ — 12⅜	12⅛	..	..	4 12 4
400,000	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	121 —124	121 —124	..	..	..	4 0 8
800,000	Do. 4½ % 2nd. Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
50,000	County of Durham Electrical Power, Ord.	5	4 %	2 %	..	..	1⅞ — 2	1⅞ — 2	..	..	..	5 0 0
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	2¾ — 3⅜	2¾ — 3⅜	..	..	..	7 8 2
250,000	Do. do. do. 5 % 1st Mtg. Deb.	Stock	..	..	..	5 %	93½ — 95½	93½ — 95½	..	..	..	5 4 9
40,000	County of London Electric Lighting, Ord. 1—40,000	10	5 %	5 %	5 %	5 %	7⅝ — 8⅛	7⅝ — 8	7⅞	7⅞	— ⅛	6 6 0
55,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	10⅝ — 11⅛	10⅝ — 11⅛	10 23/32	10 23/32	..	5 7 10
400,000	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	105 —108	105 —108	..	..	..	4 3 4
400,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	4 9 1
80,000	Edmundson's Electric Corporation, Ord. Shares	5	4 %	Nil	Nil	Nil	⅛ — ⅜	⅛ — ⅜	..	..	..	Nil
80,000	Do. do. 6 % Cum. Pref.	5	6 %	3 %	Nil	Nil	⅜ — ⅝	⅜ — ⅝	..	..	— ⅛	Nil
430,500	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	4½%	57 — 60	57 — 60	57	..	..	7 10 0
$3,150,000	Electrical Dev.Co.of Ontario, 6% 1stMtg.Gold Bnds.	$500	..	..	..	5 %	91 — 94	91 — 94	..	..	..	5 6 5
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	5½%	4⅜ — 4⅞	4⅜ — 4⅞	..	..	..	5 12 10
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	5 %	5 %	5 %	5 %	4⅞ — 5⅛	4⅞ — 5⅛	..	..	..	4 18 0
90,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	97 —100	97 —100	..	..	..	4 10 0
15,000	Hove, 1 to 15,000	5	9 %	9 %	8½%	8½%	6⅞ — 7⅛	7 — 7⅛	..	..	+ ⅛	5 13 4
$1,876,000	Kaministiquia Power Co., 5% Gold Bnds.	..	..	..	..	5 %	100 —102	100 —102	..	..	..	4 18 0
31,000	Kensington and Knightsbridge Electric Ord.	5	10 %	10 %	10 %	8 %	7 — 7⅛	7 — 7⅛	..	..	..	5 4 1
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	95 — 98	95 — 98	..	..	..	4 1 8
111,000	London Electric Supply Corporation, Limited, Ord.	8	4 %	4 %	2½%	8 %	1⅝ — 2	1⅝ — 2	..	..	..	4 8 11
70,000	Do. do. do 6 % Pref.	5	6 %	6 %	6 %	6 %	4¼ — 5⅛	4⅜ — 5⅛	..	..	— ⅛	5 17 1
832,355	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4½%	4½%	4 %	93 — 97	93 — 97	..	..	..	4 2 6
200,000	Metropolitan Electric Supply, 1 to 100,000	5	10 %	8 %	6%	5 %	3⅜ — 4⅛	3⅜ — 4⅛	..	..	..	5 17 8
76,121	Do. 4½ % Cum. Pref. 1—71,106	5	4½%	4½%	4½%	4½%	4⅝ — 5	4⅝ — 5	99/9	..	..	4 10 0
225,000	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	106 —109	106 —109	..	..	..	4 2 7
248,000	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	83½ — 86½	83⅜ — 86½	85⅞	..	..	4 0 11
$6,000,000	Mexican Electric Light Co., 5% 1st Mtg. Gold Bnds.	..	5 %	5 %	5 %	5 %	80½ — 82½	80½ — 82½	82	81½	..	6 1 3
18,585,000	Do. Light and Power Co., Ltd., Common	$100	..	..	..	3½%	71 — 75	71 — 75	73	..	..	4 13 4
$2,400,000	Do. do. 7% Cum. Pref. Stk.	Stock	..	..	..	7 %	102 —106	102 —106	103⅜	..	..	6 12 1
$12,000,000	Do. do. 5% 1st Mtg. Gold Bnds.	..	..	..	..	5 %	84 — 86	84 — 86	85⅜	84½	..	5 16 3
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	98 —100	98 —100	..	..	..	4 10 0
130,491	Newcastle-on-Tyne, 1 to 137,500	5	8 %	8 %	8 %	2½%	4 — 4⅛	4 — 4⅛	..	..	..	2 15 1
137,500	Do. 5 % Pref., 1 to 137,500	5	5 %	5 %	5 %	5 %	4 — 4⅛	4 — 4⅛	..	..	..	5 10 2
126,500	North Metropolitan Electric Power Supply Co., 5 % Mortgages (Red.), Nos. 1 to 1,265	100	..	..	..	..	99 — 101	99 —101	..	..	..	..
10,852	Notting Hill Electric Lighting	10	7½%	7½%	7½%	7 %	12⅛ — 13⅛	12⅛ — 13⅛	12⅜	..	..	5 6 0
20,000	Oxford, 1 to 96 and 407 to 20,316	5	7 %	7 %	7 %	..	6 — 6½	6 — 6½	..	..	..	6 7 8
50,000	Do. 4 % Deb. Stock	100	4 %	4 %	4 %	4 %	95 — 98	95 — 98	..	..	..	4 1 8
119,694	River Plate Elcty. Co. Ord. Nos. 1 to 120,507	1	..	2½%	6 %	8 %	1⅜ — 1⅝	1⅜ — 1⅝	31/3	..	— 1/16	4 18 6
100,000	Do. do. 6% Non Cum. Pref. Nos. 1 to 100,000	1	6 %	6 %	6 %	6 %	1⅜ — 1⅝	1⅜ — 1⅝	23/6	..	..	5 19 0
200,000	Do. do. 5% Deb. Stk. Red.	100	5 %	5 %	5 %	5 %	103 —106	103 —106	..	..	..	4 14 4
40,000	St. James' and Pall Mall Electric Light, Ord.	5	12½%	10 %	10 %	10 %	8¾ — 9	8¾ — 9	..	..	..	6 7 0
70,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	7 — 7⅛	7 — 7⅛	..	..	..	5 11 1
150,000	Do. do. 3½ % Deb. Stock Red.	100	3 %	3½%	3½%	3½%	84 — 88	84 — 88	..	..	..	3 19 7
12,000	Smithfield Markets Electric Supply, Ord.	5	4 %	Nil	Nil	Nil	1/16 — ⅛	⅛ — 1⅛	..	..	+ 1/16	Nil
55,000	South London Electric Supply, Ord.	4	4 %	3 %	4 %	5 %	2⅝ — 3	2⅝ — 3	..	..	..	6 13 4
120,000	South Met. Elec. Lt. & Power, Ord.	1	2½%	2½%	2½%	2½%	1/16 — ⅛	1/16 — ⅛	..	..	..	4 8 11
142,968	Do. do. 7 % Pref.	1	7 %	7 %	7 %	7 %	1⅛ — 1⅜	1⅛ — 1⅜	21/10½	..	..	5 17 11
224,520	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	100 —103	100 —103	102⅜	..	..	4 7 5
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	⅜ — ⅝	⅜ — ⅝	..	..	..	25 6 8
50,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	14 5 4
275,000	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	4½%	4½%	4½%	4½%	74½ — 78½	74½ — 78½	..	..	..	5 14 8
808,000	Victoria Falls Power Co., Pref. Nos. 1 to 800,000	1	..	..	..	5 %	⅝ — ¾	⅝ — ¾	18/-	..	+ 1/16	5 6 8
110,000	Westminster Electric Supply, Ord.	5	12 %	12 %	10 %	10 %	8½ — 8¾	8⅜ — 8¾	..	..	..	5 12 8
81,979	Do. do. 4½ % Cum. Pref. Reduced from 5% since 31st Dec., 1908)	5	5 %	4½%	4½%	4½%	4⅞ — 5⅛	4⅞ — 5⅛	..	..	..	4 5 9

* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange. Interim Dividend.

Bank rate of Discount 5 per cent., October 22nd, 1909

EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING OCTOBER, 1909.

As regards the export section of electrical business, but little movement has occurred as compared with the preceding month, when, it will be remembered, the total was below the average of the year. The import section, however, shows an upward tendency, having reached the highest figure recorded this year, thanks to lamp importations.

The gross export total was £265,523, an amount which includes £28,324 worth of telegraphic material, and leaves £237,199 as the total of general business, comparable with £294,753 in October, 1908.

Of the various items, the totals of electrical machinery, and telephonic and telegraphic material show a fall compared with the previous month, this being more than counterbalanced by increased totals in the majority of other sections.

As regards the imports, which amounted to £164,246—showing a recovery after the depressed returns of some months past—this total compares with £138,462 in September, and includes, as the most prominent item, £60,000 worth of lamps.

It is interesting to note that this item is some £10,000 in excess of that recorded in October last year, despite the additional lamp factories which have been established in this country in the meantime.

Machinery imports were somewhat higher, and telegraphic-telephonic imports some £6,000 less than in September.

The re-export section at £13,830 is some £4,000 less than in September.

Japan, India and the Argentine figured as the most prominent purchasers of the month, while Germany, with a total of £107,673 imports (including nearly £48,000 worth of lamps), retained its usual position as an importer.

Registered Exports of British and Irish Electrical Goods from the United Kingdom.

Country receiving exports and importing.	Electrical goods and appliances.	Wires and cables, rubber and other insulations.	Electric lighting fittings and accessories.	Electric lamps and parts.	Electric meters and instruments.	Electric machinery.	Electrically-driven machinery.	Batteries and accumulators.	Carbons.	Telephonic cable and apparatus and electric bells.	Telegraphic cable and apparatus.	Total.
	£	£	£	£	£	£	£	£	£	£	£	£
Russia, Sweden, Norway and Denmark ...	131	90	125	93	40	2,473	...	81	...	...	1,056	4,089
Germany	249	343	46	14	11	325	...	30	...	63	76	1,157
Netherlands	170	707	122	...	109	885	...	...	...	54	978	3,025
Belgium	136	293	25	87	322	778	...	18	...	178	144	1,981
France	85	...	96	490	16	1,751	...	...	...	...	118	2,556
Portugal, Madeira and Portuguese Africa ...	48	126	15	248	6	1,960	1,160	42	...	62	1,054	4,721
Spain and Canary Isles	8	100	50	80	...	585	850	46	...	14	517	2,050
Italy, Austria-Hungary and Switzerland ...	15	...	47	...	329	228	460	...	...	897	2,272	4,248
Greece, Bulgaria, Roumania and Turkey ...	91	111	43	..	..	472	...	26	...	...	508	1,251
Channel Isles, Gibraltar, Malta and Cyprus	10	30	22	16	70	275	...	12	...	...	15	450
U.S.A. and Philippines	35	...	821	11	44	731	...	...	468	...	5,213	7,383
Canada and Newfoundland	170	649	511	140	1,951	2,201	1,532	30	19	25	2,333	9,561
Bermudas, British West Indies and British Guiana	84	...	10	165	...	...	...	...	...	122	31	412
Mexico, Colombia, Panama and Venezuela ..	4	45	27	455	...	2,324	28	8	...	577	190	3,658
Peru and Uruguay	173	...	190	13	10	437	...	...	...	181	43	1,047
Chile	11	415	66	289	40	601	200	96	111	242	20	2,091
Brazil	588	315	679	467	54	3,867	49	12	...	18	141	6,190
Argentine	1,373	6,395	278	1,044	827	21,559	49	748	73	4,420	667	37,433
Egypt	336	195	99	79	...	328	18	219	54	141	212	1,681
Tripoli, Tunis, Morocco and Persia	48	...	...	...	...	945	...	13	...	...	...	1 006
British West Africa and St. Helena	25	750	13	37	104	65	...	156	...	94	5	1,219
Cape of Good Hope	718	796	251	404	123	565	175	81	...	136	...	3,249
Natal	1,077	9,275	86	280	75	1,545	110	49	420	129	97	13 143
Rhodesia and Transvaal	2,072	6,645	253	887	195	3,131	...	32	...	216	15	13,446
Zanzibar, Brit. East Africa, Mauritius & Aden	25	45	14	39	...	...	..	39	...	100	119	381
China and Siam	1,405	2 006	127	119	21	1,388	99	2,782	10	109	...	8,066
Japan	544	14,808	78	90	1,417	11,377	...	34	...	1,887	9,066	39,301
Java	11	...	...	...	...	...	...	6	...	...	806	823
India	2,181	7,755	2,948	2,661	495	8,409	10,037	2,521	212	353	1,271	38,843
Ceylon	26	56	104	131	110	363	53	298	...	23	284	1,448
Straits Settlements and Fed. Malay States...	97	472	248	468	28	626	82	56	84	215	171	2,547
Hong Kong	229	4,571	34	342	...	1,908	...	11	76	166	...	7,337
West Australia	113	20	20	284	356	630	...	366	16	153	...	1,958
South Australia...	372	304	153	70	...	3,218	...	89	...	108	56	4,370
Victoria	967	5,116	71	507	240	929	100	289	69	3,072	64	11,424
New South Wales	1,528	2,867	411	678	393	4,990	...	2,958	...	225	283	14,333
Queensland	88	122	65	226	...	518	...	14	...	...	344	1,377
Tasmania	6	...	...	...	...	...	...	...	...	30	...	36
New Zealand	1,179	1,872	360	462	49	1,717	...	46	32	220	355	6,292
Total, £	16,428	67,294	8,508	11,376	7,435	84,104	15,002	11,178	1,644	14,230	28,324	265,523

Registered Imports into the United Kingdom of Electrical Goods from all Countries.

	£	£	£	£	£	£	£	£	£	£	£
Norway, Sweden and Denmark	5	42	8	81	...	1,152	200	356	...	4,111	5,955
Germany	527	12,858	2,119	47,931	2,204	22,077	50	1,408	8,406	10,095	107,673
Holland	...	...	...	3,195	...	38	...	8	102	6	3,349
Belgium	537	1,698	86	275	177	776	11	334	488	3,907	8 289
France	12	160	684	4,740	241	2,337	...	1,200	3,599	1,709	14,682
Spain	...	...	...	214	...	...	...	...	195	...	409
Switzerland	14	22	...	106	135	1,714	8	2	19	152	2,172
Italy	29	1,032	77	...	...	2	...	...	...	428	1,568
Austria-Hungary	22	463	11	578	...	13	...	32	1,133	26	2,278
United States	2,174	1,148	743	2,589	...	6,915	3,494	431	257	120	17,871
Total, £	3,320	17,423	3,728	59,709	2,757	35,024	3,763	3,771	14,199	20,552	164,246

Registered Re-Exports of Foreign and Colonial Electrical Goods from the United Kingdom.

	£	£	£	£	£	£	£	£	£	£	
Various countries, mainly as above	2,156	1,537	...	2,292	...	3,802	...	331	1,254	2,458	...

TOTAL EXPORTS: £265,523. TOTAL RE-EXPORTS: £13,830. TOTAL IMPORTS: £164,246.

NOTE.—The amounts appearing under the several headings are classified according to the Customs returns. The first and third columns contain many amounts relating to "goods" otherwise unclassified, the latter, doubtless, consisting of similar materials to those appearing in adjacent columns.

CABLE-FAULT LOCALISATION GRAPHS IN PRACTICE.

By EDWARD RAYMOND-BARKER.

(*Concluded from page* 838.)

The Rymer-Jones Slide Resistance as a Calibrator.

In the present series of articles on graphic methods of cable-break localisation, a brief note concerning a conveniently improvised mil-ammeter may be found not inapposite. Mr. J. Rymer-Jones has shown how an effective mil-ammeter may be arranged by a combination of the Sullivan (marine pattern) galvanometer, with the Rymer-Jones slide resistances.

The Rymer-Jones slide resistances (shown in fig. 54), although applicable to many test methods, are designed

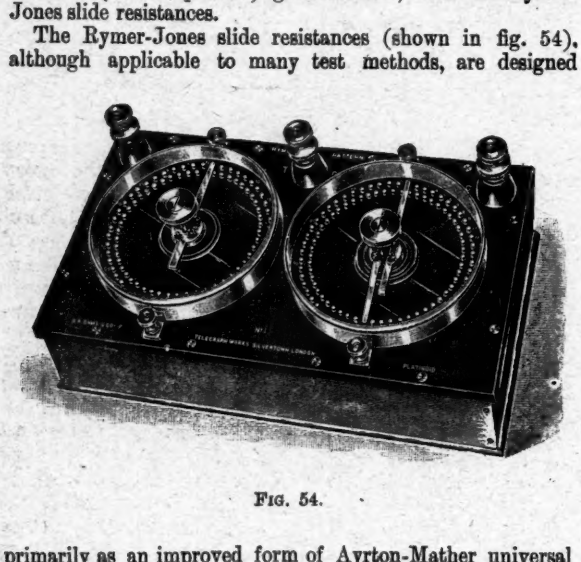


Fig. 54.

primarily as an improved form of Ayrton-Mather universal shunt (U.S.).

The following note summarises the methods by which these slide resistances can be used to calibrate the graduated scale of, *e.g.*, a Sullivan marine-type galvanometer (G) enabling this last-mentioned apparatus to be utilised as a mil-ammeter in cable-fault localisation tests ashore or afloat.

It may happen that a mil-ammeter is not available, whilst a second Sullivan galvanometer, generally used for D.R. tests, may happen to stand handy.

Fig. 55 shows comparatively the theoretical and practical arrangement of the Rymer-Jones slide resistances considered as a galvanometer universal shunt, one of the many uses to which this apparatus is applicable.

Letters between brackets give the lettering as used in practice on the outside of the apparatus.

This apparatus, though based on the principle of the Ayrton-Mather U.S., involves a distinctly improved principle of sliding-contact construction, whereby a fully ample number of possible shunt adjustments, within a conveniently limited superficial area, are obtained for a minimum number of sliding contacts, viz., 99 × 54 = 5,346 different slide values, with only three sliding contacts (in practice, platinum working against gold).

The said arrangement possesses obvious advantages: (1) Minimum change of resistance at contact points, and greatly reduced risk of contact trouble due to accidental grit or other foreign matter. (2) Simplicity of the formula for combined resistance of the shunted galvanometer.

Fig. 55 shows the Rymer-Jones U.S., as consisting of a series of 99 coils, each of 100ω, or a total of 9,900 ohms, connected between two other series, each of the last-mentioned series totalling 100 ohms. The G terminals go to two arms or contacts rigidly inter-connected, which slide along the two 100-ohm series, so that the more one series is brought between the G terminals, the more the other is excluded, and *vice versa*.

Thus between the G terminals there is a constant resistance of 10,000ω, that is, 9,900ω *plus* 100ω made up of either one, or the other, or parts of both of the two 100-ohm series.

In mil-ammeter and other special work (as in the case of the Rymer-Jones special test to localise a high-resistance break-end) a knowledge of the combined G and S resistance is sometimes needful.

In fig. 55 A and B are two resistances in simple shunt with each other.

When T_1 and T_2 are on the zero contacts of their respective series, B becomes *nil*; in other words, G and its constant shunt of 10,000ω (or whatever the total may be) are short-circuited.

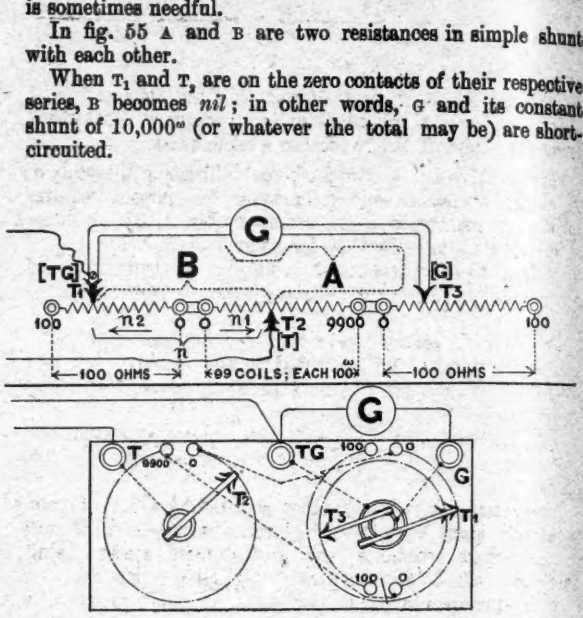


Fig. 55.

In the theoretical diagram, fig. 55:—

n_1 = slide reading of T_2 working to the right by hundreds of ohms.

n_2 = slide reading of T_1 working to the left by one or more units.

Note.—The two (out of the three) sliding contacts from which readings are taken, are drawn as double arrow heads.

Let the total slide reading of n_1 and n_2 be called n, and let G = galvanometer resistance.

It has been shown that the total slide value = [99 × 100] + 100 = 10,000 which, in this particular pattern of

Fig. 56A.

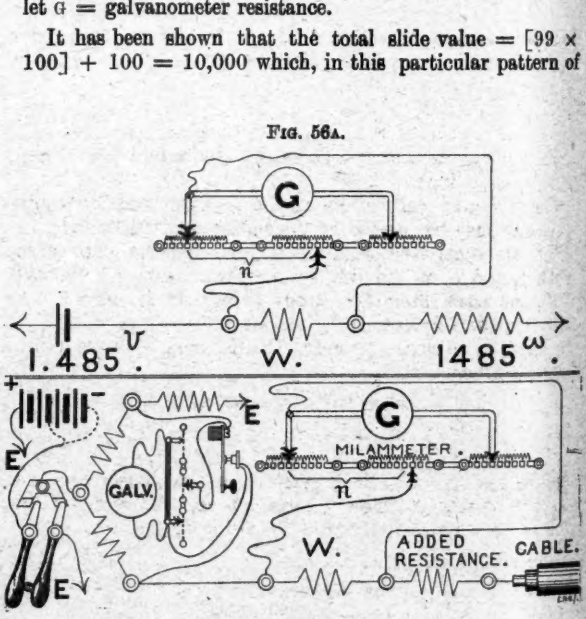


Fig. 56B.

universal shunt, represents also the total ohmic resistance always shunting the actual G terminals.

Then A = G + [10,000 − n].

B = n.

The joint conductivity of the branch circuits A and B is represented by the sum of the reciprocals of their resistances, $= \frac{1}{A} + \frac{1}{B} = \frac{A+B}{AB}$, the reciprocal of which ex-

pression, viz., $\frac{A\,B}{A+B}$, gives the joint resistance of the two branch circuits.

$$\frac{A\,B}{A+B} = \frac{[G+(10{,}000-n)]\,n}{G+10{,}000-n+n} = \frac{[G+(10{,}000-n)]\,n.}{G+10{,}000}$$

Fig. 56 shows respectively :—

(*a*) Tests for calibrating G for use as a mil-ammeter.

(*b*) Use of G as mil-ammeter in an ordinary Wheatstone bridge two-current test to localise a cable break.

Mainly there are two methods for calibrating the scale of G, though variations and refinements for various requirements are elaborated in an article by Mr. J. Rymer-Jones in the ELECTRICAL REVIEW for August 11th, 1905.

Method A.—Connections as in fig. 56A. Contacts T_1 and T_2 respectively moved to extreme slide limits—viz., to 99 and to 100.

One or two Leclanché cells of v volts are joined up ready for application through shunted G, and an extra inserted resistance of a thousand times as many ohms as there are volts in v.

For instance, if $v = 1{\cdot}485$ volts, inserted resistance = 1,485 ohms; or if $v = 2{\cdot}97$ volts, resistance = 2,970 ohms.

The shunted G is then further shunted by a coil of comparatively stout wire (W) of German silver, and of only 2 or 3 ohms resistance, the said shunted system being, therefore, reduced to a practically negligible resistance.

W is experimentally adjusted until, on the completion of the aforementioned circuit, any required convenient deflection is obtained, say, 10 divs. or 100 divs.

Now, any deflection obtained under these conditions necessarily represents $\frac{1{\cdot}485^v}{1{,}485^\omega}$, or again $\frac{2{\cdot}97^v}{2{,}970^\omega}$, that is, 0·001 amp. = 1 m.a.

The shunted G is now ready for use as a mil-ammeter (as in fig. 56B), on which a deflection of 310 divs. (W having been adjusted to give 100 divs. for 1 m.a.), would approximately represent 3·1 m.a., or 520 divs. = 5·2 m.a.

To reduce the sensitiveness of these readings, the operator, instead of lessening still further the resistance of W, may move the slide contacts T_2 (and, for final adjustments, T_1) from the maximum limit to convenient points along the slide adjustments, thereby causing V to produce any desired decrease in number of scale divs. for the given milliampere of current already explained.

Method B.—There need not be, in the beginning, any exact adjustment of W as long as this resistance is sufficiently low to bring the G *spot*, deflected by the calibrating battery, within scale limits.

Any desired calibration of the G scale used as a mil-ammeter may be effected by the sliding contacts T_2 and T_1.

In an actual example in the writer's personal experience, with T_2 and T_1 of the U.S. at maximum limits of 9,900 and 100, the extra shunt W of about 3ω reduced the deflection of G to considerably over 100 divisions.

Then, by adjusting T_2 and T_1, the following scale deflections were obtained :—

100	divisions	with slide	reading at	9,874
20	,,	,,	,,	4,962
10	,,	,,	,,	28

and as the deflection limit available on the G scale amounted to 550 divisions, these figures afforded a basis for the following three calibrations adapted for various uses.

(1) Volts (*v*) used in calibration.	(2) Approximate resistance in circuit.	(3) Current in M A.	(4) Slide reading on U.S.	(5) Scale divs. on mil-ammeter G.	(6) Scale limit in milli-amperes.	(7) Scale of calibration.
	ω					
1·485	1,485	1	9·874	100	5·5	A.
,,	,,	,,	4,962	20	27·5	B.
,,	,,	,,	28	10	55·0	C.

The ordinary divisions of the G scale were then supplemented by pencil lines and figures dividing up the scale divs. into three additional scales, viz. :—

Scale A, 100 divs. = 1 m.a. up to 5·5 m.a.
B, 20 divs. = 1 m.a. up to 27·5 m.a.
C, 10 divs. = 1 m.a. up to 55·0 m.a.

The advantage of this arrangement was that when G was taken from its customary use (which happened to be for cable D.R. tests) to serve as a mil-ammeter for cable-break localisations, all that had to be done was to connect up W and place the sliding contacts of the U.S. at that slide reading which previous experiment had shown would produce whichever of the three calibrations might be chosen as convenient for the work in hand.

Another method has been devised by Mr. C. W. Schaefer for utilising a reflecting galvanometer as a mil-ammeter, particulars of which method may be found in Mr. H. D. Wilkinson's "Submarine Cable-Laying and Repairing," second edition, page 534.

NOTES ON TRADE ABROAD.

A Tug of War and its Lessons.

JAPAN has been making a strong pull against America for the cotton trade of Manchuria and has got much of it away, whereat the U.S. Consul at Newchwang weeps and reports the reasons for the loss of the predominant position. There is little in common between cotton and electrics—though we like to electrify the mills—but we allude to the matter in order to state the reasons why the U.S.A. has lost ground before the advancing Japs, for among them are points that may be profitably regarded in connection with our exploitation of British electrical manufactures in Far Eastern markets where our brave little allies as they feel their feet may compete against even us. Japanese cottons are shipped by a direct route "right there." American cottons are first shipped to Shanghai and distributed from there, which means the addition of storage charges, commissions, &c., making prices high. That, as any baby knows, is a serious handicap in any competitive market. But further still, before the American goods reach the small dealers they must pass through the hands of numerous middlemen, whose commission must be added! What is the moral? The American Consul advises thus :—Manufacturers of piece goods should follow the lead of Standard Oils and Tobacco interests, who have compelled success by sending an energetic representative to Manchuria to protect their interests, and who ship their goods *direct* and carry stocks there. It is urged that a number of manufacturers, presumably of different departments, should jointly send an agent to arrange to keep stocks in the principal Manchurian markets, these stocks to be shipped direct, and there must be no attempt to redistribute from Shanghai. As we have said, cottons are not electrics, but the method of commercial madness being very much the same in all classes of manufactures, the advice having been given should be made a note of, so that we may be ready to do whatever Manchuria will permit electrically in the near or distant future.

An American has a fit of the Blues.

An American special agent (Captain Godfrey L. Carden) has been visiting a number of important works in Italy, and he has written home reproving American machinery makers for neglecting the Italian market. As an illustration—a very bad illustration—of neglect, he names the military small-arms arsenal at Terni; its name is Precisione d'Artiglieria della Fabrica d'Armi di Terni, and the vice-director in charge is Major Guglielmo Lucci, Cav. Santo Galbardi being the technical chief. Electric drive is employed throughout and everything is of the best, save that "in the entire lot of 1,400 machines in service, there are only 10 American." "In vain I looked for American machines, which for arsenal work are unexcelled! Turning to the technical chief, I asked if any American manufacturers had ever called." Since 1882 only one American machine-tool man had visited the works. In vain should we try to convince this confident American that anything good can come out of England. With envious eyes he looked upon those 900 machine tools supplied to Terni in the early eighties by

our own well-known Greenwood & Batley, Ltd., of Leeds—and the annoying part of it all is that they are still running! He actually finds that G. & B. received about $386,000 for the installation. Then he goes on with his story, preparing the way for the American to hang around in the hope of getting an equally acceptable order:—"Much of the Greenwood & Batley equipment is now old, and it is this material which must, in the general order of things, give way gradually to more modern and superior tools." We can imagine the excitement which this ardent American displayed when he came across "the only encouraging sign at Terni"—a recently purchased American milling machine of which the technical chief spoke highly, here a couple of American lathes, there a miller or two, to the aforesaid grand total of 10. He goes on to say that there are many types of American machine tools which could be introduced with advantage in the Terni shops. No doubt there are, but let it not be imagined that since those early eighties the British machine tool-maker has been resting upon his oars. When Americans try to get a look in replacing those G. and B. machines, the British manufacturer must see to it that *he* has a look in too, for the American tool-maker is no more necessary in Terni than he is at the North Pole. Our firms have made excellent advance in recent years, and they have devoted a good deal of study to the electric drive, and all this big talk of a disappointed special agent will not settle the Italian Government contracts if our people do their duty.

We are 10.

Messrs. Greenwood & Batley, who supplied the screw machines, will be on the alert, and so we are sure will Messrs. Alfred Herbert, of Coventry, who supplied the lathes, and the others, "mostly German," will be on the war-path too. The British manufacturer must show fight. Commercial war to the knife be it if it must. Are we ready? Let us nurse the Terni arsenal straight away, and every other arsenal. There never was greater need for alertness. That stuff still running!—and after nearly 30 years!!—tells its own tale. What a tribute to the quality of British manufactures! If you want machines to last three years, and then scrap them, we can make those too. All we want is a good chance—a fair field, and no favour.

Nurse the Arsenal.

A word more about this arsenal where so much "old" British stuff is at work. What does the Consul say about the product, and so on? "The material turned out here is of the highest grade, and the requirements on all sides are of an exacting character. The workmen are a credit to their officers and their country." In short, everything is of the best, except that "old" British equipment. Incidentally, we may add for general interest that the Terni works are supplied with about 1,000 H.P. for electric driving purposes, from eight hydraulic turbine-driven sets. 500 men are employed on a 9-hour working day, the shops opening at 7 a.m. and closing at 5 p.m.

With all that we have said in the foregoing, however, we cannot help feeling that such reports are of value to American traders. We would like to see a few reports on big works' visits from our own Consuls. They are better than generalisations.

In our detailed consideration of the outlook for British electrical trade in China, we dwelt at some length upon the American ambitions regarding that market, and the steps that our trans-Atlantic cousins were making in order to attain their desired ends. We now read in a U.S. Government trade document that "the Associated Chambers of Commerce of the Pacific Coast have sent advices to the Government at Washington, and to Consul-General Amos P. Wilder at Shanghai, that they have accepted an invitation from the Chinese Chambers of Commerce to visit China next February. The Associated Chambers include the individual chambers located at San Francisco, Oakland, San Diego, Los Angeles, Seattle, Portland, Tacoma, and Spokane; C. W. Burke is the general secretary, and J. D. Lowman president."

Let us all Kow Tow!

Shall we ask for an invitation and go and kow tow, too? We need to go to China to obtain an intelligent grasp of the opportunities, but we also want intelligent Chinamen to come here, to see what we, as engineers and electrical manufacturers, are capable of doing. Where is the Electrical Manufacturers' Association and all its former hospitality? or why not ask the I.E.E. to do something as a Trade Expansion Society? Mr. Mordey said last week that the I.E.E. must not deteriorate into a Trade Protection Society, but we are sure that he would not object to efforts at expansion. Let us invite deputations from foreign fields, consisting of the right men, and treat them as they should be treated; or, at least, let the Chambers of Commerce confer with the electrical trades when they have useful visitors. Whatever you please, so long as we do something worth the doing! Later in this article we show how our American electrical cousins have been entertaining Japanese visitors.

In a report on motive power machinery progress during 1908, U.S. Consul Brittain, of Prague, says that the greatest advance made was in the use of electricity as a motive power.

Austrian Power Progress.

In the north Tyrol and Alpine districts the water power has been widely utilised through the construction of electrical plants, furnishing many thousands of added horse-power, especially for numerous small enterprises. The inspector for the Voraelsburg district reports that out of 1,200 motor-driven factories 800 are exclusively, and 70 others partially, driven by electrical power. In the same district, where in the early spring there was a lack of water power for small factories which did not use electricity, there were many benzine motors used. The Diesel engine attained great popularity in these places.

In the central electric station in one Vienna district four steam engines, each of 800 H.P., have been replaced by two steam turbines of 5,000 H.P. each. In an electrical station in another district four turbine steam engines have been installed, giving 10,000 H.P. From Reichenberg, Prerauand Troppau come reports of the increasing use of steam turbines.

An American Consul at Chemnitz has sent home an interesting report on the rapid progress made during recent years throughout Germany in systematically training the youth of that country in foreign languages. In Chemnitz, which has such extensive trade relations with foreign lands, new facilities are available for children, enabling them to lay in good foundations for more advanced work on entering the higher schools. "The policy pursued in Chemnitz finds its counterpart throughout the Empire, and it constitutes a powerful factor in the rapid forward movement of Germany as a power in international commerce."

Commercial Tongues.

In another report the same Consul, in discussing the last industrial census of Saxony, refers to the steady growth of the proportion of the population occupied with manufacture and commerce, and to the consequent occupation of a relatively less important position of the agricultural contingent. Independent industrial activity shows a very marked retrograde movement, and the tendency of the day is clearly "toward consolidation and the elimination of the independent artisan or farmer and the small tradesman." After putting forth data, he says:—"These data all tend to show that in Saxony powerful influences are at work changing rapidly the whole fabric of industrial organisation. Concentration and consolidation are dominant features, and the elimination of independent individual units is equally characteristic of this epoch of transformation."

An American mining company has had put down in Honduras a complete plant for drilling with compressed air. U.S. Consul McClintock, of Tegucigalpa, says that from a water course 1,000 H.P. is generated. This is transmitted by overhead wires 3½ miles to the air compressor plant which operates 18 to 20 powerful drills. The plant cost £25,000, and took a year to install. The difficulties of transport were extreme. Pieces of machinery weighing as much as 12,000 lb. each were sent over a distance of 120 miles over rough mountain roads. "More than once the wagons broke down or upset, and the machinery went rolling down the mountain side, to be brought back at great labour. The wagons had to be especially constructed to haul this machinery, and in places as many as 40 oxen were hitched to a single wagon. On the down grades 30 to 40 men were employed in holding the wagon back. The same company has two electric locomotives operating underground at present, and will soon have two more working on a different level."

Transport Difficulties. A Sample.

Other Things Worth Noting.

Copies of the proposition made to the Argentine Government by Vickers, Sons & Maxim, Ltd., of London, for building docks and shops at the port of Ensenada, one hour by express train down the river from Buenos Ayres, have been forwarded to the United States as a guide to American firms of the form of proposition agreeable to the Argentine Government. A U.S. Minister is urging Americans desiring Argentine Government work to avail themselves of a "form prepared by eminent contractors of long experience in securing Government contracts." All's fair in business competition. Imitation is the sincerest form of flattery. But we hope that British firms also will study that form of proposition.

German engineers have lately been very actively engaged in Turkey in trying to secure railroad extension powers in the province of Adana. An American Consul reported home that there was an opportunity for the sale of American railroad material, but only if prompt delivery were guaranteed, as previous delays had left a nasty effect behind. Another U.S. Consul at Mersine recently reported that British and French mining engineers had been touring the Turkish province of Adana, exploring the Taurus Mountains for iron, copper, chromium, silver and lead, all of which metals are said to exist there. A large copper mine has already begun operations near Mersine, supported by French interests. A British company operates an iron mine at Anemourium. "If American interests delay their investigations, all concessions will go elsewhere." The Turkish mining laws require, first, a permit for exploration, and after a discovery is made, a formal demand for a concession. The new governor of Adana is favourably disposed to concessionaires. British electrical firms are again urged by the ELECTRICAL REVIEW to be on the alert in Turkey. For signs of new enterprise there by our firms we are profoundly thankful.

While alluding to Turkey, we may quote some remarks of the Constantinople correspondent of the *Times* :—"It is notorious that many members of the Turkish Chamber are now solely occupied in furthering the interests of native or foreign company promoters and applicants for concessions and monopolies. It is believed that proposals for legislation on this subject will be laid before the Chamber by an influential Deputy."

In regard to Greece, let it be noted by our people, that in the district of Patras merchants are at present disregarding the overtures of Americans because they have persistently neglected to quote c.i.f. prices, are unwilling to extend long credit, and have no American representatives on the spot to push certain lines of goods. "The largest and most influential importers in Patras are not only citizens of the countries from which they import, but they are in prominent instances vice-consuls of these countries, and have been so long established in Greece that their influence is widespread. If an American agent, handling several different classes of goods, should establish himself on the spot and provide a show warehouse for his specialties, he would in the course of a few months build up a very profitable business."

For its new railway extension into the State of Goyaz the Brazilian Government is to do the building and operating on its own account. This is instead of again giving contractors a 6 per cent. guaranty on a capital of $15,000 per mile. The Government issues 5 per cent. bonds to cover the cost of building.

U.S. Electrical Men Fete Japs.

The Honorary Commercial Commissioners of Japan who have lately been touring through the United States spent November 5th in inspecting industrial works at Pittsburg. The Carnegie Steel Co.'s mills at Homestead were inspected in the morning, and after luncheon the party went by special train to East Pittsburg, where the works of the Westinghouse Machine Co. were visited, the construction of steam turbines, gas engines, steam engines and condensers, being observed. Next the works of the Westinghouse Electric and Manufacturing Co. received attention. Here, according to the New York *Electrical Review and Western Electrician*, a number of Japanese guides took the party in charge and showed them the various departments, where the manufacture and testing of generators, motors, transformers, and other auxiliary apparatus of all types and sizes were in progress. Considerable attention was naturally directed to the large electric locomotives being built for the New York terminals of the Pennsylvania Railroad. With Japan about to move forward in railway electrification, anything of this kind might be expected to leave an important impression on the Japanese mind. At East Liberty a dinner was given in honour of the visitors, who were treated as the special guests of officers of a number of the Westinghouse Companies, and the success of the event was due to the toastmaster, Mr. W. M. McFarland, acting vice-president of the Westinghouse Electric, &c., Co., "whose personal greeting to each guest was greatly appreciated." Covers, it appears, were laid for thirty, and for the interest of our readers we give the following list of some of the specially honoured guests :—

Baron E. Shibusawa, chairman of the commission, president First Bank.

Mr. Buei Nakano, member of the House of Representatives, president of Tokio Stock Exchange and Tokio Chamber of Commerce, director of Tokio Electric Railway Co., Ltd.

Mr. Michio Doi, president of Osaka Chamber of Commerce, Osaka Electric Light Co., Ltd., and Naniwa Electric Railway Co., Ltd., director of Osaka Godo Cotton Spinning Co., Ltd., and Ujikawa Hydro-electricity, Ltd.

Mr. Jihei Nishimura, president of Kyoto Chamber of Commerce, director of Kyoto Shoko Ginko and Kyoto Textile Fabric Co., Ltd., member of House of Representatives.

Mr. Kahei Otani, director of Yokohama Water Works Bureau, president of Yokohama Seventy-fourth Bank, and Japan Tea Manufacturing Co., Ltd., director of Yokohama Electric Wire Co., Ltd., member of Yokohama Chamber of Commerce

Mr. Tominosuke Katono, managing director of Meiji Ginko and Nippon Cars Manufacturing Co., Ltd., director of Nagoya Electric Power Co., member of Nagoya Chamber of Commerce.

Mr. Heizaemon Hibiya, president of Kanegafuchi Cotton Spinning Co., Ltd., director of Fuji Gassed Cotton Spinning Co., Ltd., and Tokio Woollen Textile Co., Ltd.

Mr. Sakutaro Satake, president of Tokio Electric Light Co., Ltd., and Tenth Bank, Kofu, director of Kabuto Beer Brewery, Ltd.

Mr. Kaichiro Nezu, member of House of Representatives and Tokio Chamber of Commerce, director of Tobu Railway Co., Ltd.

Dr. Riuta Hara, doctor of engineering, engineer of Yokohama Water Works Bureau.

Mr. Narazo Takatsuji, director and chief engineer of Kanegafuchi Cotton Spinning Co., Ltd.

Mr. W. M. Zumoto, editor and proprietor, *Japan Times*.

Consul General K. Midzuno.

It might happen that these gentlemen would like to know what their British allies are doing electrically. Eh?

MORE NOTES FROM INDIA.

[FROM A SPECIAL CORRESPONDENT.]

Simla.—Active operations are in progress in the long-distance hydro-electric scheme for Simla, and it is expected that the work will be complete by the time Government go up there next March, unless any unforeseen circumstances due to climatic conditions arise. The work is under the immediate supervision of Mr. C. Wilson, executive engineer, P.W.D., Punjab, who has been deputed to devote his whole energies to it.

Calcutta.—The more favourable power rates offered by the C.E.S. Co. to large power users should induce many mill-owners to take advantage of the undoubted economy of electric motor driving. Already one large new Jute Press has an entire equipment of electrical machinery supplied by the Lahmeyer Co., through their agents, Messrs. Shaw, Wallace & Co., and its operation is being watched with keen and critical interest by steam-users.

Allahabad.—An Industrial Exhibition is to be held in Allahabad in December, 1910, on a scale commensurate with the importance of the united provinces of Agra and Oudh. From an electrical point of view this will be important, as conditions in this province are very favourable to the application of electrical distribution for irrigation from wells and other sources of water supply. The exhibition authorities are to be commended for giving such timely notice of their proposal, and all particulars may be had from the Secretary, United Provinces Exhibition, Allahabad, who will be glad to forward prospectuses and all necessary information.

The post of Electrical Inspector to Government U.P., lately filled by Mr. R. P. Russell, has been conferred on Mr. J. S.

Pit Keathly. This gentleman, who represented Messrs. Bruce Peebles & Co. on the Mussoorie hydro-electric scheme during its construction, has recently returned to India to take up his new post.

Government electrical contracts in India during the current year have been few and far between, owing to the small budget sanctioned for P.W.D. purposes. Generally speaking, trade all round is bad, but signs are appearing which indicate that prospects are better and brighter.

A NEW FIELD-MAGNET SYSTEM.

By J. W. BURLEIGH.

The writer has recently designed a new field-magnet system for dynamos and motors. It is proposed in this article to describe this magnet system and to put forward some data in connection therewith.

On referring to fig. 1, it will be seen that a departure is made from the usual radial-pole type of machine.

The main magnet system is arranged in a special manner, and may be said to consist of a number of horse-shoe magnets with commutating poles arranged as shown. The angle θ between the axis of a main pole core and the axis of a commutating pole $= \frac{360^\circ}{N\,P}$, where N P equals the number of main poles.

This is a distinctive feature of the design. The arrangement of the poles and windings is shown diagrammatically in fig. 2. The full line represents a winding of a series-wound armature; the dotted lines the portions of the field coils, and the rectangles the commutating poles. Portions A A, fig. 1, of the main exciting coils are brought directly over and parallel with the armature conductors undergoing commutation. This particular position of the field coils lessens

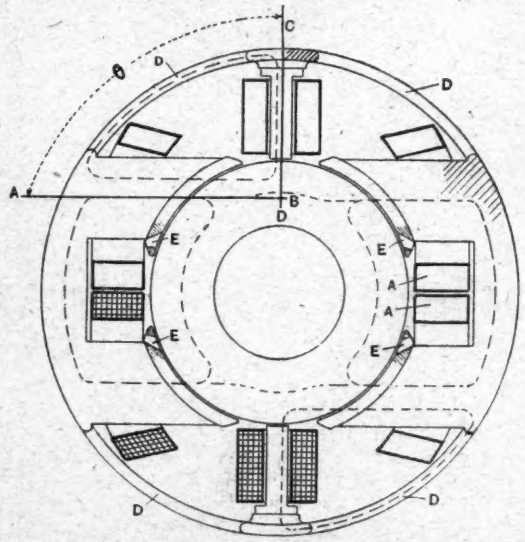


Fig. 1.—New Field-Magnet System.

the self-induction of armature coils undergoing commutation and saves a considerable amount of copper on the commutating poles. From actual tests it would appear that the excitation required on each commutating pole is not in excess of that required for each commutating pole in a machine having an ordinary magnet system, in which the number of auxiliary poles and main poles are equal. It is found, too, that the brush position is not nearly so sharply defined as in the usual commutating-pole machine.

With this particular construction magnetic leakage is reduced to a minimum. I have tested several small machines, and in no case could detect more than 10 per cent. leakage.

This reduction in magnetic leakage, combined with the short iron path, makes an extremely light field system. In addition to the foregoing merits, the ventilation is much better than in the usual type of construction. Portions D D, being required only to carry the commutating flux, may be cut away, leaving large ventilating spaces. The excellent ventilation thus provided will doubtless admit of larger current densities, not only in the field windings, but in the armature coils as well.

It will be found that, notwithstanding the extra thickness of yoke required in places for main flux, the outside diameter

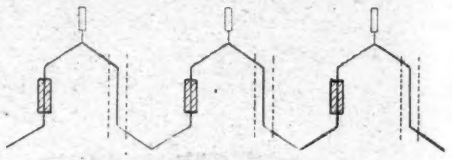


Fig. 2.—Diagram of Winding.

is not greater than in an ordinary machine. In fact, if the field coils are slightly formed, as shown, the external diameter will be less.

One of the machines made on this principle was a 500-volt crane-rated motor developing 12 B.H.P. at 1,050 revs. The armature of this motor was constructed originally for a machine of quite a different type, and it is therefore to be understood that the dimensions given would be modified in a fresh design. This machine, however, will serve to illustrate some of the characteristics of the new design :—

Motor (Crane-Rated) 500 v., 12 B.H.P. at 1,050 R.P.M.

Diameter of armature	8 in.
Length of armature	6½ in.
Number of conductors	1,644
Number of commutator bars	137
Diameter of commutator	7 in.
Number of slots	46
Diameter of bore main poles and auxiliary poles	8 3/16 in.
Area of field magnets (steel)	9·2 sq. in.
Area of yoke (steel)	6·2 sq. in.
Area of yoke (cast-iron)	8·5 sq. in.
Calculated amp.-turns without allowance for leakage	2,100
Shunt turns	3,894
Auxiliary turns	148
Weight of armature copper	15½ lb.
Weight of shunt copper	32 lb.
Weight of auxiliary copper	17 lb.
Weight of cast-steel	70 lb.
Weight of cast-iron	145 lb.
Weight of armature laminations	53½ lb.

Temperature rise after one hour's run at 20·5 amperes through armature :—

Armature	68° F.
Commutating-pole coil	60° F.
Main-pole coil	57° F.

Size of commutating-pole	4 in. × ¾ in.
Reactance volts (calculated by Hobart's method)	6·9 volts
Mean reactance	4·4 volts

Density required (commutating pole) =

$$\frac{\text{Mean reactance volts} \times 10^8}{L \times V} = \beta,$$

where $L = 2 \times lc \times 1{\cdot}1 \times T$,

lc = Effective length of conductor,

T = Turns per section,

V = Peripheral speed of armature in centimetres per second,

$$\therefore \beta = \frac{4{\cdot}4 \times 10^8}{115 \times 1{,}110} = 3{,}460.$$

Ampere-turns required for commutating-pole gap	660
Ampere-turns per pole on armature	2,100
Ampere-turns allowed for iron path	300
Total ampere-turns on commutating pole	3,060

With ordinary radial pole construction, using only two auxiliary poles, the ampere-turns required for each pole would be at least 3,060 + 660 = 3,720; whereas with the improved design 3,000 ampere-turns were ample, the commutation being perfect. The magnetic leakage in this machine was not more than 7 per cent. Sectional views of the motor are shown in fig. 3.

Results similar to the above have been found in several small machines constructed by the writer. The commutation in all cases was perfect, and the brush position was not nearly as sensitive as in the ordinary commutating-pole machine. The saving in material is a great deal more than one would expect at first sight; in some cases the saving

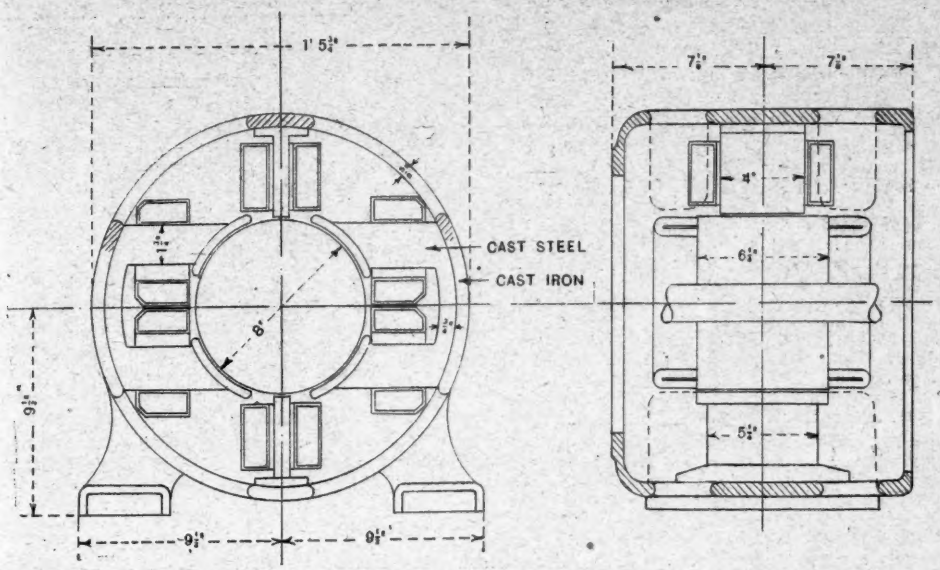


Fig. 3.—Sections of 12-b.h.p. Motor.

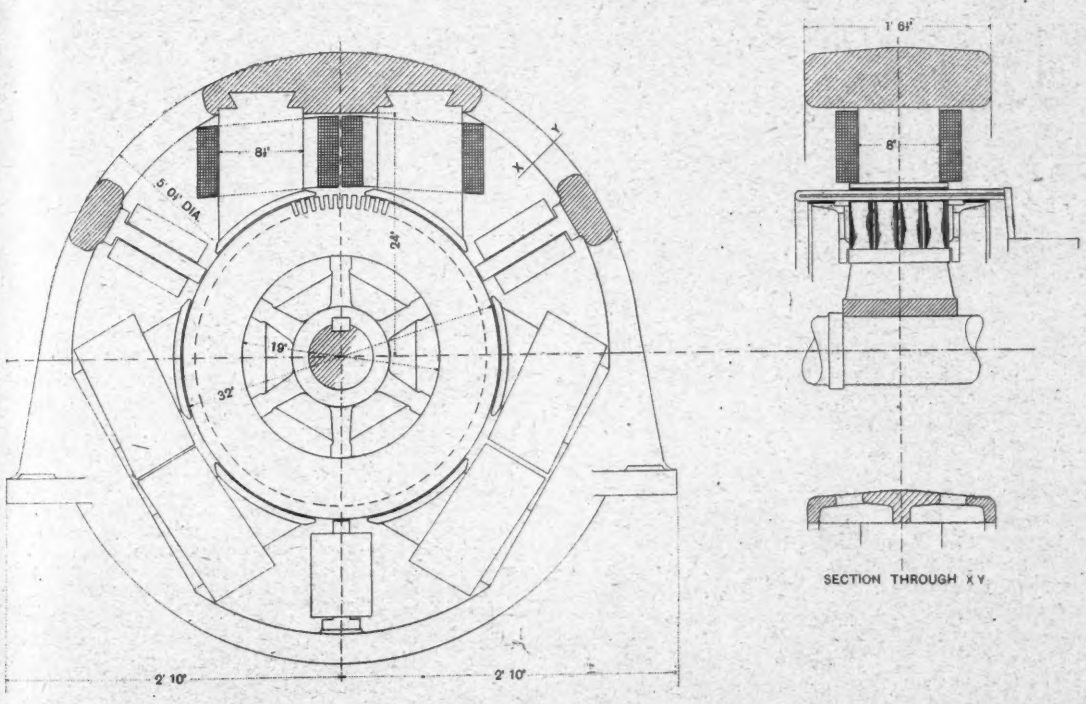


Fig. 4.—Design for 200-kw. Dynamo.

amounts to 20 or 30 per cent. on the total cost of effective material.

Proceeding on the lines shown, I have roughed out a design for a 500-volt 200-kw. dynamo, running at 400 r.p.m. (fig. 4). Probably, for the final design, it may be desirable slightly to modify some of the details. The figures given, however, will serve as an indication of what may safely be anticipated in the larger sizes.

500 Volts, 400 Amperes, 400 r.p.m.

Number of poles	6
Diameter of armature (external)	32
" " (internal)	19·5
Gross length of armature	10 in.
Number of ventilating spaces	3
Width of vent	⅜
Net length of armature	8 in.
Number of slots	104
Width of slot	·46 in.
Depth "	1·31 in.
Number of conductors	416
Size of conductor	·15 in. × ·50 in.
Current density, amperes per sq. in.	2,680
Number of commutator sections	208
Diameter of commutator	22 in.
Effective length of bar	6½ in.
Flux (megalines)	6·18
Density in armature	12,200
" teeth	21,500
" air-gap	8,700
Ampere-turns required at full load (per pole)	8,000
Main-field watts	1,850
Mean length of turn	42 in.
Weight of copper (pounds)	616
Length of commutating pole	6 in.
Width "	1½ in.
Commutating-pole watts, total	570
Weight of commutating-pole copper (pounds)	150
Resistance of armature (warm)	·0335 ω
Armature c^2r watts	5,420
" hysteresis	2,900
Total armature watts	8,320
Cooling surface (outside)	2,110 sq. in.
Watts per sq. in.	3·94
Weight of armature copper (pounds)	302
" " disks	1,000
" cast-iron in magnets	2,500

Weight of wrought-iron in magnets	1,500
„ laminated shoes	155
„ field copper	766
Cost of armature copper	£12·6
„ „ disks	15·2
„ magnet cast-iron	12·5
„ „ wrought-iron	5·7
„ „ shoes	1·6
„ „ field copper	31·9
Total cost of effective material ...	£79·5
Reactance volts (calculated)	4·8
Volts per section	14·4
Armature ampere-turns per pole	7,000
Armature-core loss	2,900
„ c^2R loss	5,420
Total field loss	2,410
Brush friction	470
„ contact	812
Bearing, windage, &c.	1,400
Total loss, watts	13,422
Efficiency at full-load	93·8 %

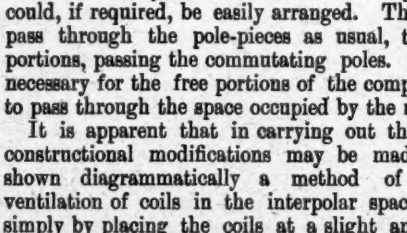


Fig. 5.—Method of Improving Ventilation of Field Coils.

A PENNSYLVANIA ELECTRIC LOCOMOTIVE.

A locomotive of more than ordinary interest, one of 24 on order, has recently been tested on the Long Island Railway by the Pennsylvania Railroad, which company's trains it is intended to handle into New York station. The mechanical work was carried out at the company's Altoona shops, and the electrical equipment has been supplied by the Westinghouse Co., East Pittsburg.

The locomotive is of the articulated type, each half carrying its own motor, and being mounted on four 68-in. drivers and a four-wheel swing bolster truck with 33-in. wheels. The two sections are complete in themselves, being duplicates, but are permanently coupled and designed for driving from either end. Each motor weighs, without gears, 45,000 lb., and is rated normally at 2,000 h.p., with forced ventilation, if required by continuous operation.

As will be seen from our view, the motors drive by cranks at 90°, through a system of coupling rods on to the driving wheels, the arrangement resembling at first sight steam practice, but substituting the constant torque of the motor for the intermittent action of the steam cylinder. The centre of gravity approximates to that of the high-speed steam locomotive.

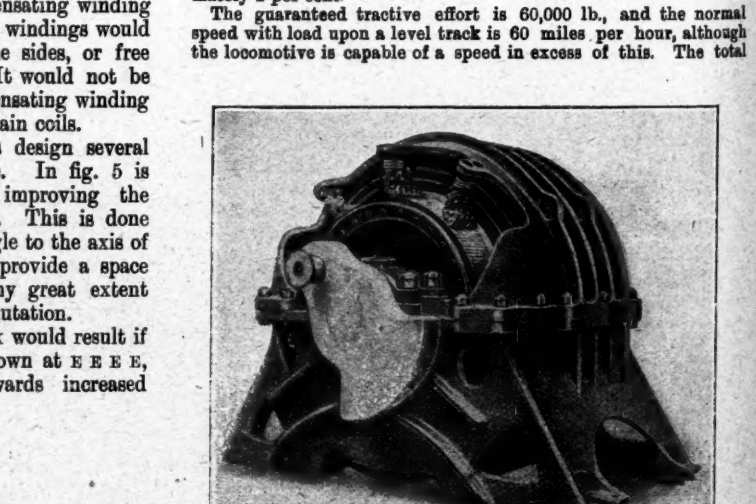


Diagram showing Arrangement and Dimensions of Pennsylvania Electric Locomotive.

According to the *Railway Gazette*, which published the views here given, the starting requirements of the locomotive are unusually severe, as it will be called on to start a train of 550 tons trailing load upon the tunnel grades under the river, which are approximately 2 per cent.

The guaranteed tractive effort is 60,000 lb., and the normal speed with load upon a level track is 60 miles per hour, although the locomotive is capable of a speed in excess of this. The total weight of the locomotive is 332,100 lb., of which 208,000 lb. is carried on the drivers; the rigid wheel base of each half is 7 ft. 2 in., and the length of the complete machine 65 ft.

2,000-h.p. Motor for Electric Locomotive.

Turning to the electrical equipment, each motor is provided with 10 main and 10 inter-poles; the main field is split in two halves, both being used together in slow speed operation, and one of them shunted in control. The armature is relieved from excessive driving strains by the interposition of a novel friction clutch between the spider and motor shaft. The motors operate on 600-

Constructions based on the writer's design should be particularly applicable where large calculated reactance voltages are concerned, as (as before pointed out) in virtue of the main field coils being disposed as described, the effective reactance volts must be considerably less than the calculated figure.

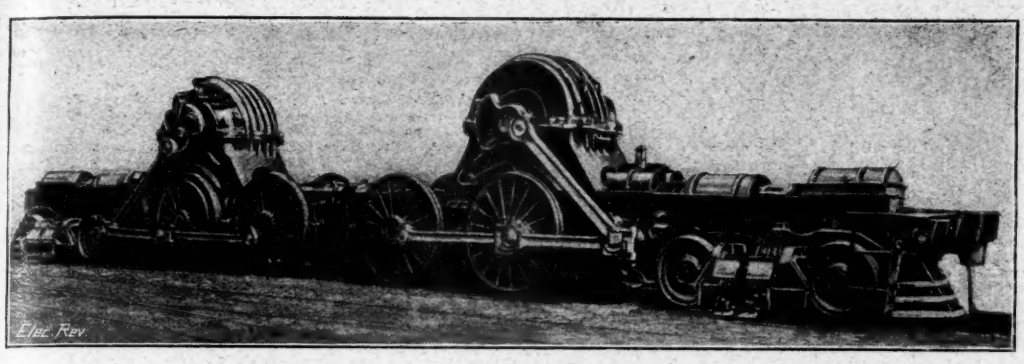
In a turbo-dynamo an additional compensating winding could, if required, be easily arranged. The windings would pass through the pole-pieces as usual, the sides, or free portions, passing the commutating poles. It would not be necessary for the free portions of the compensating winding to pass through the space occupied by the main coils.

It is apparent that in carrying out this design several constructional modifications may be made. In fig. 5 is shown diagrammatically a method of improving the ventilation of coils in the interpolar space. This is done simply by placing the coils at a slight angle to the axis of the armature core. This enables one to provide a space between these coils, and should not to any great extent lower their effectiveness in facilitating commutation.

Probably, too, a better distribution of flux would result if holes were provided in the pole-shoes, as shown at E E E E, fig. 1—there certainly is a tendency towards increased density at these tips.

Radio-dermatitis.—A further operation has been carried out upon Mr. H. W. Cox, owing to the continued progress of the disease, which has not been confined to his hands and arms. Mr. Cox's arm was amputated above the elbow on the 13th inst., and since then his progress has been favourable. As one of the pioneers over whose lives a blight has been cast by their pursuit of X-ray research, Mr. Cox has our profound sympathy, as well as, we are sure, that of our readers.

Rifle with Electric Sights.—According to a Consular report, a German engineer named Issel has adapted "a telescopic searchlight containing a small electric lamp" to a rifle, so that the user can take aim at distant objects in complete darkness. Details are wanting.



View showing Motors coupled to Driving Wheels, Pennsylvania Electric Locomotive.

volt direct-current, each half-unit being fitted with two pairs of rail shoes, also with a small pantograph collector mounted on the cab, for use in the yards.

The motors are controlled on the Westinghouse shunted field system; electro-pneumatic switches actuated by air from the brake compressor, and operated by magnets controlled from a master controller, provide for regulating the fields by shunting and cutting out a section of the winding, in addition to series-parallel grouping. The bridging system is used for passing from series to multiple connections, and the motor fields are arranged to be reversed for changing the direction of rotation, reversing being by means of unit switches.

A master controller is placed in each of the cabs and arranged for operating two or more locomotives from any one controller. The resistances are of sufficient capacity to enable a locomotive to run with one motor out of service. Duplicate small storage batteries are provided on each half-unit for energising the control circuits. On an official test over a 6-mile course, the first locomotive hauled a 6-car train at an average speed of 63 miles an hour.

OUR LEGAL QUERY COLUMN.

[Questions addressed to this column should be written on one side of the paper only.]

"High Pressure" writes:—"The following case has come under my notice:—A company supplying electrical energy for lighting and power purposes received an application form for the supply of power, duly signed, but without any particulars as to the purpose for which it was intended to be used. From private sources the supply company in question had information that the power was to be used for driving a gas compressor for high-pressure gas lighting, which would displace an installation of arc lamps already in use. The company refused to accept the application. Are they within their rights in doing so? I should perhaps mention that the supply company is working under a provisional electric lighting order. I should be very pleased to receive your comments on this question."

*** The point raised is one of some difficulty. It has been met and dealt with in a modified form in this column on former occasions. In order to answer it, it is necessary to consider the obligations imposed on supply companies by statute. In the first place, it is clear that a company must supply to all consumers in their district without fear or favour. By Sec. 19 of the Electric Lighting Act, 1882, "where a supply of electricity is provided in any part of an area for private purposes, then, except in so far as is otherwise provided by the terms of the order . . . . every company or person within that part of the area shall, on application, be entitled to a supply on the same terms on which any other company or person in such part of the area is entitled under similar circumstances to a corresponding supply." Again, by Sec. 20, the undertakers must not show any undue preference to any authority, company or person. Subject to these provisions, a company may make such charges for the supply of electricity as may be agreed upon. All the foregoing principles apply to the supply of electricity for power as well as for lighting. Now, there is nothing in the statutes which would authorise any company to make any inquiry into the objects to which the electricity supplied for power is to be devoted. It is true that many companies supply at different flat rates for special classes of consumers. But supposing there is a charge advertised of 2½d. per unit for motive power generally, there does not seem to be anything to compel the consumer to disclose the objects for which he intends to use the power. Coming now to the facts of the present case, there does not appear to be anything to warrant the company refusing to supply power for an indirect motive. It must be admitted that there is no actual decision of the Courts to support this view, but it is impossible to see whither one would be led if the contrary view were to prevail. A company might object to supply current to a man who was using a motor-generator with a view to lighting his premises at motor rates; that would be a colourable evasion of the law. In the circumstances detailed by "High Pressure" there does not appear to be anything fraudulent on the part of the consumer.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

Amendment.

AUSTRALIAN COMMONWEALTH.—The Government, in the *Gazette* of September 18th, publish a Customs By-Law (No. 66, of September 16th) laying down the conditions for the admission of high-speed reciprocating steam engines for direct coupling or directly coupled to electric generators or to pumps, into the Commonwealth of Australia under item 160 (B) of the Customs Tariff of 1908.

It is provided that, unless they comply with the following conditions, such engines shall not be admitted under the above tariff item, which provides that they may be admitted free of duty when the manufacture of the United Kingdom, but otherwise are subject to a duty of 5 per cent. *ad valorem*:—

(*a*) The engine must be of the vertical reciprocating type, and must be provided with forced or splash lubrication.

(*b*) The working parts of the engine must be enclosed in an oil-tight case or chamber.

(*c*) The engine must be mounted, or for mounting, on the same shaft, or be coupled, or for coupling in one line by means of couplings, with an electric generator or a pump, so that the engine and the generator or pump will run at the same number of revolutions per minute.

(*d*) The number of revolutions per minute at which the engine is constructed to run continuously, when developing its maximum brake horse-power, must not be less than the number of revolutions per minute represented in the speed curves of high-speed engines shown in the schedule attached to the By-Law, for the given brake horse-power, according as the engine is of the single, two or three-crank type.

It is, however, provided that when an engine complies with conditions (*a*), (*b*) and (*c*), and is normally constructed to run at a standard speed not less than that defined or represented in the said speed curves, but, owing to the special requirements of the electric generator or pump with which it is, or is to be, directly coupled, must be run at a lower speed, such engine will be admitted under tariff item 160 B upon the production to the Comptroller-General or a State Collector of Customs of satisfactory proof that the engine is a modification of a standard type the normal speed of which is not below that defined or represented in the said speed curves.

The importer is further required to satisfy the Comptroller-General or State Collector of Customs that the engine complies with the foregoing conditions, and that it will only be used for direct coupling to an electric generator or to a pump.

The French Lamp Duty.—The scheme for the revision of the French import duties, which is now engaging the attention of the Chamber of Deputies, provides for an increase of the present high duty on metallic-filament lamps from £7 to £10 per cwt. In this connection a German electrical correspondent states that the French makers of incandescent lamps will be in error if they assume that the proposed Customs augmentation will diminish foreign competition and enable them to obtain a corresponding advance in prices. On the contrary, he remarks that the large German works which at present export metallic-filament lamps to France, will doubtless erect branches in France after the introduction of the prohibitive duty, and that they will then offer more serious competition to French industry. As an instance of how little the glow lamp industry requires a high protective duty, the correspondent mentions that the metallic-filament lamp branch has been very favourably developed in Germany, notwithstanding the relatively low duty of £2 per cwt.

NEW PATENTS APPLIED FOR, 1909.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 286, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

25,711. "Automatically-operated switch, for use with cranes and other machinery operated or controlled by electrical means." G. E. Pearson. November 8th.

25,718. "Improvements in magnetic compasses." Kelvin & J. White, Ltd., and F. W. Clark. November 8th.

25,719. "Indicating connectors and regulators for electric circuits." N. Hoscood. November 8th.

25,733. "Improvements in and relating to electric fuse fittings." Siemens Bros. Dynamo Works, Ltd. (Siemens Schuckertwerke G.m.b.H., Germany.) (Application for Patent of Addition to No. 8,263/09.) November 8th. (Complete.)

25,734. "Improvements in the electrical propulsion of ships." Siemens Bros. Dynamo Works, Ltd., and M. Kloss. November 8th.

25,757. "Improvements in and relating to telephones and the like." H. O. Quinn. November 8th.

25,785. "Improvements in alternating current dynamo machines." Hon. C. A. Parsons and A. H. Law. November 8th.

25,795. "Hollow brick lamp which can be lit or illuminated by either the ordinary gas mantle or electric bulbs and used for lighting the names of streets or advertising purposes." J. W. Shephard and G. Brown. November 9th.

25,822. "Improvements relating to metallic conduits for electric conductors." B. L. Myer. November 9th.

25,882. "Improvements in telephone exchanges." Siemens Bros. & Co., Ltd. (Siemens & Halske Akt.-Ges., Germany.) November 9th. (Complete.)

25,883. "Improvements in telephone exchanges." Siemens Bros. & Co.' Ltd. (Siemens & Halske Akt.-Ges., Germany.) November 9th. (Complete.)

25,887. "Improvements in automatic telephone systems." W. A. Yewen. November 9th.

25,889. "Improving the quality of metallic-filaments." H. Kuzel. (Date applied for under Sec. 91 of the Act, December 21st, 1908, being date of application in Germany.) November 9th. (Complete.)

25,896. "Improvements in and relating to electric selective devices especially applicable to telephone systems and the like." American Automatic Telephone Co., and C. L. Goodrun. November 9th. (Complete.)

25,920. "Novel or improved flexible protection for electric cables and the like purposes." E. L. Pease. November 10th.

25,962. "Improvements in electrical mercury switches operated by a vehicle passing along a railway." Siemens Bros. & Co., Ltd. (Siemens and Halske Akt.-Ges., Germany.) (Application for Patent of Addition to No. 6,073 of 1905.) November 10th. (Complete.)

25,972. "Improvements in and relating to homopolar electrical machines." R. H. Barbour. November 10th.

25,973. "Improvements in and relating to homopolar electrical generators and motors." R. H. Barbour. November 10th.

25,989. "Improved method of and means for producting electrical oscillations." Marconi's Wireless Telegraph Co., Ltd., and H. J. Round. November 10th.

26,005. "Improvements relating to the ventilation of electric motors." H. A. Mavor and Mavor & Coulson, Ltd. November 10th.

26,006. "Improvements in or relating to incandescent electric lamps." H. J. Jaeger. November 10th. (Complete.)

26,021. "Improvements in or relating to electric conduit joints and joint boxes." W. R. Sykes and V. J. Cooke. November 10th. (Complete.)

26,036. "New and improved switch and circuit-breaker for high potential circuits." J. N. Kelman. November 10th.

26,046. "Improvements in and relating to polyphase alternating current commutator machines." Allgemeine Elektricitats Ges. (Date applied for under Sec. 91 of the Act, November 11th, 1908, being date of application in Germany.) November 10th. (Complete.)

26,051. "Improvements in switching arrangements for electric stone-cutting and stone-drilling machines." R. Rohde. November 10th.

26,088. "Improvements in switching devices for use in connection with electric lighting or power." W. C. Kirwan and K. Quaney. November 11th.

26,099. "Improvements relating to the support of electrical conductors or cables." T. G. Noble. November 11th.

26,146. "Improvements in and relating to dynamo-electric machines." Allgemeine Elektricitats Ges. (Date applied for under Sec. 91 of the Act, November 12th, 1908, being date of application in Germany.) November 11th. (Complete.)

26,167. "Improvements in and relating to electric cells and the method of using same, and in the application to certain articles of electric light." P. C. Pace, L. Hunter and A. E. Lamkin. November 12th.

26,250. "Improvements relating to electric cables." Siemens Bros. and Co., Ltd., and W. Dieselhorst. November 12th.

26,251. "Improvements in and relating to electric furnaces." J. Harden. November 12th. (Complete.)

26,266. "Improvements relating to electric furnaces." J. Harden. November 12th. (Complete.)

26,269. "Improvements in telephone exchanges." Siemens & Halske Akt.-Ges. (Date applied for under Sec. 91 of the Act, November 14th, 1908, being date of application in Germany.) November 14th. (Complete.)

26,289. "Improvements in automatic electric switches." T. Ferguson. November 13th.

26,322. "Improvements in controllers for electric tramcars and the like." H. J. E. Sayer and C. Freeman. November 13th.

26,347. "Improved current collector for electrically-propelled vehicles." Willy-Kohler. (Date applied for under Sec. 91 of the Act, May 1st, 1909, being date of application in Germany.) November 13th. (Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of Messrs. W. P. Thompson & Co., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1908.

Receiving Installations for Wireless Telegraphy. W. Burstyn. 15,854. July 20th.

Means for Observing the Condition of the Sparking Plugs and the Explosions in Internal-Combustion Engines specially applicable for Motor-Cars, Motor-Cycles, and for similar purposes. A. J. Riley. 16,328. August 1st. Post-dated March 1st, 1909.

Arrangements for Storing and Distributing Alternating Currents of Electricity. A. M. Taylor. 29,044. October 19th.

Electric Railway System. W. Robinson. 22,227. October 20th.

Electric Batteries. Basset. 22,236. October 20th. (Date applied for under International Convention, October 31st, 1907.)

Overhead Conductor Gear for the Propulsion of Vehicles Electrically. British Insulated and Helsby Cables, Ltd., and J. W. Astley. 22,413. October 22nd.

Electric Arc Lamps. S. C. Mount. 22,454. October 22nd.

Method of and Apparatus for Controlling the Voltage of Dynamo-Electric Machinery, especially applicable to Variable-speed Generators. W. Stansfield and J. W. Hatt. 22,500. October 23rd.

Means for Supporting Electric Lamp Brackets or the like on Walls. J. J. Rawlings. 25,053. October 29th.

Systems of Electrical Distribution by Alternating-Current Transformers. J. S. Peck. 23,064. October 29th.

Means of Transport for Portable Electrically-driven Pumps for Fire Brigade or for other purposes. W. A. Stevens. 23,398. November 2nd.

Electrolysis of Liquids. J. Billiter. 24,594. November 16th.

Electric Switches. G. Sweetser. 27,213. December 15th.

1909.

Stage Arc Lamps and other Similar Lamps. J. F. Walters. 15,532. January 30th.

Insulating Former-Wound Coils. Siemens & Halske Akt.-Ges. 16,985. September 29th. (Date applied for under International Convention, July 21st, 1908.)

Arc Lamps. T. L. Carbone. 17,448. July 27th. (Date applied for under International Convention, November 9th, 1908.)

Flame Arc Electric Lamps. Siemens Schuckertwerke Ges. 18,328. August 9th. (Date applied for under Internationa Convention, August 11th, 1908.)

Sparking Plugs for Internal-Combustion Engines. W. V. Williams. 2,934. February 8th.

Prepayment Electricity Meters. G. Hookham and S. H. Holden. 3,217. February 10th. (Application for Patent of Addition to No. 2,769, 1908.)

Portable Electric Lamp Fittings. L. A. Williamson. 3,836. February 16th.

Electric Signalling and Ringing Key. M. S. Conner. 4,270. February 22nd.

Electrically-driven Rotary Pumps. A. S. Mallinson. 4,928. March 1st.

Telephone Exchanges. Siemens Bros. & Co. (Siemens & Halske Akt.-Ges.) 6,281. March 16th.

Automatic Electric Block Signal Systems. H. W. Price. 6,289. March 16th.

Electric Street-Car Indicator. H. E. Fisher. 6,818. March 22nd.

Process for the Manufacture of Non-Carbon Electric Incandescent Filaments of Refractory Metals or their alloys. W. Heinrich. 7,092. March 24th.

Electric Glow Lamps. F. Farber. 7,913. April 2nd.

Electrical Apparatus for Locking Levers, Operating Railway and other Switches, Signals, and the like from a Distance. Soc. Ch. Legrand et Cie. 8,168. April 5th. (Date applied for under International Convention, April 9th, 1908.)

Train-Controlling Means on Electric Railway Systems. W. Robinson. 9,623. April 22nd. (Application, under Rule 13, for the date of October 20th, 1908.)

Section Insulator for Electric Tramways. J. C. Russell and A. P. Lord. 11,210. May 12th.

Arc Lamp with Conducting Supporting Member. B. Duschnitz. 11,578. May 17th. (Date applied for under International Convention, September 22nd, 1908.)

Arc Lamp in which the Feed of the Electrodes is Effected by the Action of the Current at the Point of Support. B. Duschnitz. 11,579. May 17th. (Date applied for under International Convention, June 30th, 1908.)

Telephone Exchanges. Siemens Bros. & Co. (Siemens & Halske Akt.-Ges. 14,239. June 17th.

Control of Polyphase Motors and the like. British Thomson-Houston Co., Ltd. (Allgemeine Elektricitäts-Ges.) 17,370. July 27th.

Telephone Exchanges. Siemens & Halske Akt.-Ges. 18,456. August 10th. (Date applied for under International Convention, October 2nd, 1908.)

Telephonic Apparatus. E. A. Graham. 21,002. September 14th.

New Processes at Siemens's Works, Woolwich.—

The students attending Mr. Kilburn Scott's lectures at the Northampton Institute, Clerkenwell, recently visited Messrs. Siemens's works at Woolwich, and were shown several novelties.

The Stannos wire-making machine is only about 2 ft. long, and it consists of a spiral tube into which the insulated wire and a flat strip of tinned copper about an inch wide is fed. The interior of the spiral tube is so shaped that the flat strip is pressed round the insulation twice, thus—

There is no seam in the finished product. The two layers of copper form one tube by being sweated together as the wire passes over half-a-dozen Bunsen burners.

The enamelling process is being used for wires for instruments varying from ·004 to ·02 in. diameter, but there is no reason why in time larger wires should not be successfully treated. The process is certainly a great advance on the old double cotton and silk covering. The wire to be covered first passes through a bath of japan, and then travels through a stove about 10 ft. long, heated to 650° F. At the other end it again goes through some japan, and then travels back through the stove. This is usually repeated three times, giving a thickness of $\frac{1}{1000}$th of an inch, but, of course, more enamel can be put on if necessary. Experiments were made to show that when the copper is permanently stretched the enamel stretches as well. The insulation is so good that the wire has been successfully employed for mine exploders.

In the cable department the students were shown the first submarine telephone cable to be fitted with Pupin coils. The cable is three-core, and a self-induction coil is wound along each core for a few feet at intervals of several miles. The amount of self-induction is adjusted to exactly neutralise the capacity of that part of cable it is intended to take care of.